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Virna Julisa López

Exploring Higher Education in Honduras:

towards a new learning concept with contributions of biology of knowledge

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Gutachter

Prof. Dr. Rolf Arnold

Technische Universität Kaiserslautern

Fachbereich Sozialwissenschaften

Fachgebiet Pädagogik

Gebäude 57

67663 Kaiserslautern

Zweitgutachter

Prof. (em.) Dr. Joachim Münch

Fachbereich Sozialwissenschaften

Fachgebiet Pädagogik

Gebäude 57

67663 Kaiserslautern

Das Kolloquium fand am *15. März 2013* statt.

DEDICATION

To my beloved children,

Dag, Lilly, and Gustavo

continuous source of inspiration and strength

To you,

Who never left me alone

AKNOWLEDGMENTS

In recent years, there has been an ever-increasing amount of talk about collaborative learning and teamwork in the academic world. While doctoral work remains, by its nature, an individual process, it is also true that it is impossible to do it alone. I started writing my thanks as I went forward in my work because I became increasingly convinced that it would have been an impossible mission to complete without the help, the support, or the company of many people.

First of all, I would like to thank my children, who were always patient and bravely accepted the dramatic changes that this new phase of life accounted for us. I hope it has helped us be more humble and more persistent in our life goals.

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"If I have seen further it is only by standing on the shoulders of giants".
(Isaac Newton, 1676)

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ABSTRACT

There is growing international concern about the necessity to re-think the university so that it might remain relevant in a modern society. In the traditional task division at universities, knowledge is the main resource. Universities make use of both the cognitive and the informational approach. It was expected that universities use each approach to improve overall university performance. To effectively use the informational approach, universities should apply the tools from knowledge management. To effectively use the cognitive approach, universities must update their teaching-learning strategies to incorporate some of the recent advances in neuroscience and biology of knowledge, specifically from neurobiology and autopoiesis. With this frame, the main contribution of this work is the result of merging pedagogy and biology, towards an ideal future university. This goal was achieved through an exploratory study conducted to identify opportunities and difficulties in improving the teaching-learning process for the future of higher education in Honduras. The Delphi Study was used as a predictive method. Nineteen Honduran experts participated in this study, and two rounds were necessary to achieve consensus.

The multi-disciplinary approach of this research addresses three different fields whose core element is knowledge. First, input from the present field of higher education is used to speak about the future. Second, input is taken from the biology of knowledge, and its contributions from neurobiology and autopoiesis that allow modifying and completing the already existing learning theories with a biological basis. Third, input is taken from the knowledge process, which is traditionally used as an organizational tool and know is translated to the individual level. The exploration shows that experts are concerned about all the missions and responsibilities of universities, but they agree that changes should primarily take place in the teaching dimension. Even though they are not aware of the possible contributions of biology, they suggest new forms of teaching that more favor skills development, promotes values, pertinent knowledge, and personal development over short-term contents. The resulting BRAIN Model encompasses the ideal future of higher education regarding teaching and learning, according to experts' answers. It provides a useful guide that any reform in teaching should take into account for a holistic, integral, and therefore more efficient learning task.

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Chapter I – INTRODUCTION

Scientists and philosophers have proposed many conclusions about self-consciousness and knowledge in one way or another from their intuitive understanding, but never, to my knowledge, with an adequate biological and epistemological foundation (Varela & Maturana, 1979.).

With the creation of the university hundreds of years ago, the issue of knowledge became an issue of preponderance of and in these higher education centers. Society gave universities the exclusive privilege to produce, use and transfer knowledge, all at the same time. According to Nowotny et al., *"... during the course of the twentieth century the university became the key knowledge – production institution, at any rate in large parts of northern and western Europe and in North America. Modern society has not created any institution to rival universities for the production of new knowledge"* (Nowotny, Scott, & Gibbons, 2002, p. 79).

At the present time, higher education has gained new attention in its role grappling with global challenges. University communities are called to be agents of social change. The new demands, new contexts, new trends, of the knowledge and information age require new ways of doing things. However, is higher education evolving according to these demands?

Kim (2010) addresses this issue, explaining that today's higher education ecosystem teems with vibrant organizations. Yet, the signs of evolution seem less evident, and its clock speed seems to be extremely slow. Either no competition with the dominant species exists, or environmental pressures have not reached a level sufficient to force evolution. In the worst-case scenario, people might be fine with the way teaching and learning take place today. Nonetheless, the higher education ecosystem has been evolving because of environmental pressures but extremely slow. According to Garrison & Vaughan (2008, p. ix) higher education institutions recognize the untenable position of holding onto past practices that are incongruent with the needs and demands of a knowledge society. Higher education leaders are challenged with positioning their institutions for the twenty-first century.

As it will be discussed later, the scientific community worldwide agrees in the need for a new direction for higher education, but practical questions as where, how or what should change remain practically unanswered. According to Rama (2005), a dilemma for higher education that is increasingly complex with the development of the knowledge and information society is that education should not deliver knowledge with short validity or, even worse, to emphasize evaluation in memories of knowledge that becomes obsolete quickly.

In the dynamic of higher education, different missions and domains are close intertwined making difficult to identify where to begin making changes. This thesis suggests beginning with the teaching dimension, assuming that by doing this it will inevitably promote changes in other dimensions.

The learning-teaching process has been widely studied, investigated, and documented. From the neuroscience perspective, learning is a lifelong adjustment of interconnections in the brain to the environment; they enable us to respond appropriately to situations with which we have only been faced with once (Bear, Connors, & Paradiso, 2009, p. 822). From the educational point of view, learning is defined as competence – building acquisition of knowledge, capacities and skills (Arnold, 2005, p. 39). Teaching traditionally has been a teacher-centered knowledge transfer activity; however, new learner-centered theories are taking the attention of educators. The paradigm in higher education is shifting from a focus on teaching to a focus on learning. This means a change of many different elements in all levels of higher education institutions.

In the past, learning theories have been based on social and psychological theories, but the biological phenomena underlying the learning process have been underestimated. This idea follows Maturana & Varela's studies (1974), who invite us to "know the know". They said that, if it is possible, this is the way to know ourselves, and thus understand the surrounding problems of the society and to find solutions to the ongoing problems.

Correspondingly, the increasing information arising from the brain research opens a new possibility to introduce changes in the teaching-learning process. It is possible to take advantages of new discoveries emerging from recent studies and advance how we learn from a neurobiological perspective. This thesis presents a biologically-based approach from neurobiology and autopoiesis, using doors opened by these fields to

develop new learning approaches or modifying those that already exist. It suggests that the knowledge transfer tradition of learning should be turned into a knowledge management basis on the individual level.

Knowledge management has been scarcely developed in higher education institutions. A literature review shows only a few documents about knowledge management experiences in universities (see Arsenijevíc, Tot, & Arsenijevíc, 2010; Mohaydin, Azirawani, Kamaruddin, & Margono, 2007; Malik, 2005; Steyn, 2004; Rowley, 2000; Wedman & Wang, 2005; among others), which invariably focus on the organizational dimension of knowledge management. Previous attempts have been an extrapolation from experiences of other fields and environments. As stated before, knowledge in higher education institutions is more than an organizational resource, and its concern extends beyond employees and employers.

Even though the discussion about the definition of knowledge in the scientific environment is not finished, we certainly know that we are in the "knowledge era", or the "knowledge and information era". Knowledge and information are two sides of the same coin, and frequently these terms are interchanged. As society faces both every day, we are the knowledge and information society. For the purposes of this research, knowledge will be handled like a higher cognitive function with a biological basis, and therefore residing in human bodies (and other living beings), while information could be both a source and a result of knowledge. The tiny limits between both of them will be discussed later.

Keeping knowledge in the center of the discussion, this research tries to awaken an old reflection and to develop a deeper one: teaching and learning in higher education in the optics of cognitive biology. To this end, the present and the future of higher education institutions in Honduras have been explored through a Delphi Consult. This was considered a necessary step in order to explore the scenario and identify opportunities to introduce a new learning approach, characterized by using a knowledge management tool at the individual level and consequently to improve the teaching-learning process by moving it towards a bio-psychosocial approach.

PURPOSE OF THE STUDY

The present thesis is the result of an exploratory research, which intends to re-organize the thinking of Honduran experts about the future of higher education. Because knowledge is the key resource at universities, this study identifies the meaning of knowledge, the use of knowledge management as a tool in Honduran universities, and the possibilities to introduce a new learning approach in higher education. By doing this, it will be possible to determine the relevance of a biological basis of learning and to find the way to introduce this new element to the traditional psychosocial learning paradigm.

To reach this purpose, the study links a wide range of concepts that are not traditionally related, and views them through new lens; specifically, this means generalist instead specific, systemic instead reductionist, and transdisciplinar instead monodisciplinar. Its exploratory character makes it generalist, and its transdisciplinar approach is evident as it combines pedagogy, biology, cognition and knowledge management.

It is very important to keep in mind these considerations when reading this document. These elements give this research an added value considering research and innovation are increasingly interdisciplinary, inter-institutional, and international, generating vast amount of data (CAUDIT, 2010, p. 10). In addition, there is consensus on the importance of encouraging interdisciplinary research and cooperation in doctoral studies (see Blythe, Hasewend, & Laget, 2004).

Since university has not been an object of study in Honduras, this thesis is far from getting specific answers for specific problems. Instead, it seeks to identify the main problems, and poses possible solutions by bringing together the emperical results from the experience of national experts with global trends literature based, thus opening new opportunities for research.

RATIONALE OF THE STUDY

In the article "The Future of Higher Education" (CAUDIT, 2010) the author states: "*The world is changing faster than it has ever done before, and the pace of change will continue to accelerate. Our national ability to master that process of change and not to be ground down by it depends critically upon universities. Our future success depends upon mobilizing*

even more effectively the imagination, creativity, skills and talents of all our people. And it depends on using that knowledge and understanding to build economic strength and social harmony".

Society changes, it is a dynamic system; its possibilities, opportunities and necessities differ from one day to other. In such a system, all the gears seem to move rapidly compared to the rate at which universities are moving. This discrepancy is causing a destabilization of the educational system, and the appearance of alternative routes or new sources to maintain the system at a rate commensurate to the dynamics of society.

While industrialized and knowledge-economy-based countries (e.g. Germany) and regions around the world are deeply concerned about the role of universities in this new era, in Honduras as in many less developed countries the importance of knowledge as a driver of social development is not recognized. As it will be discussed later, this lack could be related to the understanding of knowledge. In turn, the understanding of knowledge could define the relevance of this resource not only in the socio-economic development but also in the teaching – learning process. Therefore, the role and responsibilities of Honduran universities as major institutions managing knowledge is not enough recognized in relation to the development needs of the country. Consequently, universities do not do their own to prepare professionals with skills and capabilities that will enable them to take advantage of a global trend; on the contrary, with few exceptions in the form of individual initiatives, they remain stagnant since the beginning of university in Honduras in 1847.

University is undoubtedly an important gear in the social system in terms of knowledge and information. However, the profile of current students is different from the profile of students from one or two decades ago. They grow up in an environment where access to information and knowledge is more widespread than ever; an environment to which they return after finishing their studies, faced with continuous change and new, unknown scenarios.

With the rapidly-changing socioeconomic environment, the role of higher education institutions as knowledge providers has been scrutinized and challenged by various stakeholders. Universities need to change and update their knowledge-based missions. The relevance of biology for the learning process increases providing new direction as a

result of: a) advances in cognitive neuroscience research; b) application of biology of cognition theory. This research merges the necessities with the opportunities to move towards a new learning perspective.

STATEMENT OF THE PROBLEM

This research addresses the following problems:

1. **Despite the new tendencies and scientific advances in field of learning based on neurobiology and biological theory of cognition, teaching and learning in higher education, specifically in Honduras, are stagnant in ancient paradigms.**

There are many emerging learning theories that are mostly focused on the learner (e.g. self-organized learning; independent learning; biographic learning; self-oriented learning). However, previous theories based mainly on behavior observation are still more widely known and practiced. The biological foundation of knowledge as cognitive process is relatively new, and as such its potential to enhance the educational process is still underestimated. Even though learning is a living process, attempts to merge pedagogy with biology are still weak.

2. **The understanding of knowledge and knowledge management in higher education institutions in Honduras is poor, as well as its importance in improving university performance. This under-standing determines the knowledge-related processes.**

Knowledge is a first-order resource in universities. Even though it is implicit in daily activities, there is no evidence of knowledge management neither at the organizational nor the individual level. Knowledge management as a strategy to bring together the problems of the university, and utility as a tool to find a better development of higher education institutions has been scarcely explored. Moreover, there are only a few papers that are focused on the organizational

dimension of knowledge management rather than in the individual level and its relevance for the learning-teaching process.

3. **Past problems take the full attention of educational managers, clouding the present and precluding an anticipation of future. Consequently, even when the necessity for change is evident, change comes late and they stay in the past.**

Higher education institutions in Honduras are very busy solving the problems of the past, and, as a result, do not have time to care about the future. Ignoring the past as school of the future would be as big a mistake as not looking to the future to anticipate it. Otherwise, the future is always surprising the present.

This research does not try to find an absolute answer to the questions surrounding the role of universities in the knowledge society. It tries to find the gaps in higher education and to include support from biology, specifically in neurobiology and autopoiesis theory, to strengthen the readiness to new knowledge-based learning-teaching processes from a new perspective. It considers the role that individual knowledge management could play in this new perspective.

RESEARCH QUESTIONS

The following questions are addressed by this research:

- **How should higher education institutions prepare students for success in life in an ever-changing world? What should be the future mission of higher education?**

The world in which higher education plays a significant role, as well as the world of higher education itself is changing because of environmental pressures. Key drivers include the development of advanced communication and technological services, increased international labor mobility, the focus on knowledge in society, and the growing importance of lifelong learning (Knight, 2005, p. 1).

Universities are key to the development of the knowledge-based society. This research tries to collect the thinking of experienced Honduran academics and to compare it with

trends and actions of European universities. This allows the readiness to new approaches to be assessed by analyzing futures scenarios proposed by experts, and opportunities to be found to introduce recent information of brain research and biological theory of cognition in a new learning approach with a vision of future.

- **Knowledge is often said to be the main resource of universities, but what does the concept of knowledge mean? Which specific actions reflect the management of knowledge at the university? Where are the opportunities? Where are the difficulties?**

Universities deal with information and knowledge as main resources. However, the perception of knowledge determines the way we cope with this resources at universities (see Chen & Chen, 2006). For the purpose of this investigation and in order to keep the scope manageable, knowledge is defined as an exclusively human condition; embodied in, and used by human beings. It is never the same as information (It will be widely discussed on Chapter 2). Among the scarce publications about knowledge management on higher education, Ríos and Ferrer (2007) point out that universities should be leaders in this process. However, as Agouridas & Race (2007, p. 64) say, since knowledge management is such a wide-open area of study, it is difficult to understand its implications for educational settings.

By identifying the meaning of knowledge and the relevance of knowledge management for experts, this research intends to explain how universities deal with their main resource, knowledge, through its core activities (knowledge transfer and knowledge production) in a time of ever-expanding information.

- **Which relevance do recent neurobiology findings have for learning and teaching in higher education?**

Neurobiology, as a field of Neuroscience, studies the biological basis of higher processes of mind, such as learning and conscious. For the purposes of this research, learning is understood as the process of translating information into knowledge (see Chapter 2). Acquiring and using knowledge is referred as cognition (Mingers, 1991), which, according to Maturana and Varela (1979, pp. 5-7) is simultaneously a biological process and a function.

This research intends to identify based on the literature, if recent findings of neurobiology are able to be implemented in teaching-learning processes in higher education, and how such an implementation would be enacted.

- **What relevance does autopoiesis as the biological theory of cognition have for learning and teaching in higher education?**

An autopoietic unit is a system that is capable of sustaining itself by an inner network of reactions that re-generate all the system's components (see Varela, 1974; Varela, 1979; Varela, 2000; Maturana & Varela, 1979; Maturana & Varela, 1984). In other words, an autopoietic system organizes the production of its own components (Luisi, 2003). The term was suggested to understand the organization of living systems in relation to their unitary character (Maturana & Varela, 1973, p. 75) and as a necessary condition to ensure life processes.

The scope of this research question is, on the one hand, to explore on a theoretical basis the implications of this concept on the individual in relation to its willingness to learn, and, on the other hand, to analyze the potentials and limitations of introducing this concept in the teaching-learning processes in higher education.

SIGNIFICANCE OF THE STUDY – CONTRIBUTIONS AND LIMITATIONS

Given that knowledge is the main resource at university, this study seeks to understand the present, and to explore the future of higher education in Honduras through the consultation of experts. Completing this goal means identifying the spaces to introduce new approaches to the learning-teaching process taking advantage of recent brain studies and using knowledge management in the individual level as a learning tool.

The aim of this study is to draw the attention of different stakeholders in higher education to the importance of a new paradigm in the learning process; a holistic view that integrates recent contributions of biology of cognition, neurobiology, as well as autopoiesis. It tries to promote a link between usually separate two fields, biology and pedagogy, and, therefore, to enlighten a possibility to improve, not only the individual capabilities but also the institutional efficiency.

By collecting the experience and expertise of renowned experts of higher education in Honduras, this is a valuable document and the first in its kind. It has a great potential as a tool of change, innovation, and general management in higher education institutions in Honduras and similar countries.

Specific contributions of this thesis come from the theoretical work as well as from the empirical work and they can be addressed as follows:

- Theoretical work:
  - ✓ State-of-the-art in the topic of biology of knowledge and knowledge management in higher education.
  - ✓ A translation from the organizational level of knowledge management to the individual level in higher education.
  - ✓ Development of an integrative model towards a new learning approach.

- Empirical work:
  - ✓ For the first time, the collective thinking of national experts comes together in a systematic work, in a common vision and in an exercise of imagining the future.
  - ✓ This collective thinking is a powerful contribution of the know-how of experts which is a baseline for further studies.
  - ✓ It opens a reflection among academics about the future of higher education in Honduras.

As in any study, this one has also some limitations related mainly to the possibility to generalize. The field study was conducted in a specific context, Honduras during a specific and sensible time. On the one side, there was a vivid discussion about the autonomy for each university; on the other, universities were trying to adapt themselves to a National Plan that had never existed before.

Moreover, answers and contributions of experts were more conservative than really oriented to change or to a new model of university, which permitted the panel to reach consensus with just two rounds. Honduran university has been rarely an object of study.

Therefore, to compare or to refer to previous studies is almost impossible because of the lack of information.

The results present a unilateral opinion; there are other stakeholders, students, lecturers, and administrators that should be also consulted in order to have a more objective perspective.

This research does not propose a one-size solution for universities in Honduras and is far from being a last word in merging biology and education. On the contrary, it is just a first step to awake the interest of educationists and manager of higher education institutions in taking advantages of the most recent findings of neurobiology in benefit of education, and to prepare them to welcome modern approaches in the century of neurobiology.

METHODOLOGY

The selected methodology is the Delphi Consult. It was developed between the 1950s and 60s by Rand Co. as a process based on dialogue (Schulz, 2009, p. 11). Its central assumption is that the collective judgment and wisdom of several experts is better than the estimates and predictions of any one individual. Like other analytic techniques, it is mainly used to make estimates, or to predict future human behavior and future human social conditions.

It is an iterative process that usually requires at least three rounds; however, five to six rounds are not uncommon (Strauss & Zeigler, 1975, pp. 1-2). The number of rounds required is unpredictable as it depends on how much consensus or divergence there is in the group.

As every method, Delphi has advantages and disadvantages. The major advantage to use Delphi is that it permits the researcher to obtain an objective consensus of expert judgment on the subject under study. It also makes the rationale underlying a specific estimate or prediction explicit to everyone. The main weakness is that a truly perspicacious expert's judgment might be lost when a consensus representing a range of judgments is presented. Therefore, it is important to include judgments outside the consensus in footnotes or appendixes, as appropriate (*ibidem)*. In addition, it is clear

that even proven experts are not always able to give the correct information about future events even in their field. Both sides were deeply analyzed and discussed before choosing this method. All the details about the methodology are presented in the respective chapter.

In this case, 19 Honduran experts participated in the study. As a requirement, all of them should have held or should be holding a position as president or vice president at an institution of higher education. The input used to prepare the first round of questionnaires was the result of a careful selection of sources, books, articles, conference proceedings, and others related to the topic of interest. The sources include authors from different disciplines, spanning from sociology to neurobiology, including biologists, educators, philosophers and others. The nationality of experts was considered. All information was carefully selected to integrate the various findings into a coherent whole. Answers to the first questionnaire were used to prepare a second questionnaire, this time a closed one, using the content analysis method to identify similarities and dissimilarities. Using analysis of frequencies, consensus was achieved after the second round as it is presented in results section.

SUMMARY OF INTRODUCTION

In 2005, the Massachusetts Institute of Technology created the Picower Institute for Learning and Memory, which focuses the talents of a diverse array of neuroscientists on a single mission: unraveling the mechanisms that drive the quintessentially human capacity to remember and to learn. In the inaugural conference, "Vision of the Future" (Picower Institute for Learning and Memory, 2005), worldwide renowned biologists awarded with Nobel Laureate in Physiology or Medicine, like James Watson (1962); Susumu Tonegawa (1987); Eric Kandel (2000); Sydney Brenner (2002) and Richard Axel (2004); were asked about the future of the brain and brain research, and they agree that a very important issue in the near future is the integration of natural science with humanities, social sciences and engineering.

Teaching and learning processes in higher education is a very complex issue, but pertinent knowledge should face complexity as Morin in his report "*Les Sept savoirs nécessaires à l'éducation du future"* says (see Morin, 1999). Biology fundaments are not the panacea, but approaching Biology to Pedagogy can help to understand the success

and the failure of university in its goal to prepare professionals for today's and future's society. To understand the biological foundation of learning means to push forward in neurobiology as well as the theory of autopoiesis, and to apply new knowledge with a scientific basis in educational context. It could be helpful to re-think not only the methodology but also the curricula and the structure of higher education systems.

In sum, the educational profession could benefit from embracing rather than ignoring contributions of biology. Moreover, educationists should be actively involved, and contribute to the research agenda of future brain research. In doing so, we advance to a bio – psycho – social position that welcomes multi-disciplinary perspectives in current educational challenges. This is the endeavor of this thesis.

STRUCTURE OF THE THESIS

The structure of this document is as follow: the first chapter, "**Introduction**", includes the rationale of the research as well as a general overview of the research as a whole. The next three chapters are the theoretical frame of this study; chapter two, "**Higher Education: the need for changes**", presents the literature review around the present and the future of higher education, an overview to global trends with emphasis in Honduras. Chapter three, "**Biology of knowledge: potential contributions to higher education**", presents the theoretical basis for knowledge from a biological perspective, it includes specific information about neurobiology and autopoiesis. Chapter four, "**Knowledge management: a necessary tool to better use the knowledge resource in higher education**", intends to present knowledge management at universities, with an overview to its uses and applications in the individual level as a tool to improve the learning-teaching process. The fifth chapter, "**Research Questions**" explains the research drivers in enough detail to understand their scope and objectives, as well as the assumptions and premises adopted to formulate the questions. Chapter six, "**Research Methodology**", contains a description of the Delphi Study, the expert consultation that was used as tool to carry out the empirical work of this research. In chapter seven, "**Research Findings**", the results of the research are presented, as well as its interpretation and analysis. Finally, in chapter eight "**Discussion**", implications, recommendations, limitations and suggestions for new research are presented. A complete list of **Literature** follows chapter six, along with **Annexes**, which include the interviews, questionnaires and all relevant information to support the research.

Chapter II – HIGHER EDUCATION: the need for changes

> *It has long been recognized that higher education institutions, particularly universities, are among the most stable and change resistant social institutions to have existed during the past 500 years. Based on conventional models, these institutions have effectively fulfilled this responsibility in the midst of political and social upheaval, social development, and technological advancement while remaining essentially unchanged in structure and method. Will this proven model retain its resilience and relevance in the 21st century?* (Gibbons, 1998)

This chapter shows the scenario of study in a theoretical basis. It outlines concerns about the current role of higher education, the need for changes, and suggested changes from both an international and a regional perspective. It presents the results of selected international studies, conferences, initiatives, projects, and efforts, as well as the opinion of connoted experts in the field of higher education. The empirical work was conducted in Honduras. Thus, for a better comprehension of this study's results, context concerning the current state of higher education in Honduras is presented here as well; the experts' opinion is highly influenced by the current socio-economic situation, where corruption at every space and level is evident, and criminality makes Honduras one of the un-safest places in the world (UNODC, 2011, p. 23).

THE ROLE IN THE PRESENT AND FUTURE EXPECTATIONS IN HIGHER EDUCATION

The relevant role that higher education institutions play in society becomes clear by looking around and understanding that socioeconomic development worldwide is usually under the responsibility of people that have at least a graduate level education. With just few exceptions governments, industries, enterprises, banks, financial offices, health services, environmental protection or spatial affairs all around the world are led by professionals coming from universities. Moreover, the delicate task of preparing teachers, which in turn will educate children, young people and also adults, falls mainly

on university professionals. Society has given individuals that attain higher education a great privilege, which implicitly comes with a great responsibility. However, both privilege and responsibility are not in the scope of daily tasks. Few efforts are being made to update higher education according to the changing environment, and to adapt it at the same rhythm to which the context changes.

University communities are called to be agents of social change. New demands, new contexts, new trends, require new ways of doing things. Innovation and creativity should be strong points in every university to face issues regarding current and future world problems. The role of higher education has gained new attention as well as its commitment with global challenges.

Before looking to the future, is necessary to analyze the present with respect to the past. In different time periods, university managers and other experts have posed many questions about what makes a satisfactory university, and the future of university. However, given the accelerated speed of changes in society, this topic is nowadays more effervescent than ever.

LOOKING BACKWARD

As stated before, universities are centrally-placed organizations in any society. Their main role since the Medieval Age has been the production of knowledge, both in terms of generating new knowledge (research) and embodying this knowledge into human resources (education) (Blythe, Hasewend, & Laget, 2004, p. 22). Even though the goal of a university has remained consistent throughout the years, their dynamic, emphasis and support have been slightly different from one time to another or from one context to another. A brief socio-historic narration of the evolution of university is presented below, following Brical (1997 as cited in Trillo (1997):

> *Until the fifties, the universities were characterized by their correspondence with any of the models or styles described by Brical (1997):*
>
> - *The 'Napoleonic' style, whereby universities are public institutions, dependent on the central government, with government funding, and focused on teaching, although the research work is also taken into account.*
> - *The Anglo-Saxon style, which emphasizes the personal development of students to reach the most comprehensive education possible. Therefore it*

proposes the stay of students in the campus, particularly important are universities and colleges tutorials, to ensure the coexistence and the proper behavior of the students.

- *The German tradition style known as Humboldt style, is distinguished by the early assimilation in the last century of the new experimental science, and argues that universities should be organized on the basis of academic freedom and the self-feeding of science generated by selfless and autonomous professors/scientists.*
- *The style of the countries of Eastern and Central Europe, developing until the breakup of the Soviet Union, in which the ministries exercised supervision over the various academic programs according to criteria of functional dependence, and in which research was not the responsibility of the university but of the academies created for this purpose.*
- *In the sixties and seventies, as a result of population growth and the affinity with a social policy concern for greater equality and distribution of wealth, universities grow in number and became home to a growing number of students, thus resulting the so-called "mass university".*
- *In the eighties, the economic recession and the preponderance of other social needs, such as health and pensions, make society have increasingly felt that the University is enjoying excessive privileges and need to reduce their funding. Another model was developed; we can call "neoliberal" whereby governments, on behalf of society and budgetary constraints, urge universities to undo its historical ties with the states, replacing the idea of government service by adaptation to market demands.*
- *Finally, in the nineties universities were still in search of new forms of relationship between political power (which tends to be inhibited or procrastinating) and academia. While the funding is restricted, social demands (internationalization, diversification, new technologies, etc.) and student numbers continue to rise. At the time, two new foci appear polarize all eyes: it is the "quality of higher education" (whatever that means) on the one hand and on the other, their assessment, conceived primarily as an activity for accountability. Something, of course, that is assuming further putting into question the autonomy.*

ANALYZING THE PRESENT

While many universities today retain their role as the 'critic and conscience of society', the critical function of universities has increasingly taken on a more pragmatic role in terms of staying 'relevant' in a rapidly evolving techno-economic environment. We have often heard the lament that higher education is somewhat disconnected from the society that it is supposed to serve; a criticism most infamously represented by the Socratic metaphor of the 'ivory tower' – a university perched on top of a hill amongst the clouds producing 'useless' knowledge irrelevant to disciples descending down to the real world.

Loh et al. (2005, p. 200) state that the push for higher education to become relevant to the changing needs of society was echoed by a series of reports by the World Bank (1998; Stiglitz 1999a, 1999b), as well as the Association of Commonwealth Universities (Gibbons 1998) in the late 1990s. This call for relevance in higher education, or pragmatization, arose out of various drivers and trends in the transition towards a knowledge-based economy – the heterogeneity of knowledge production, massification and democratization of higher education, and the integration and assimilation of information technology into the academic environment.

In other words, in the knowledge-based economy and society there are new demands; the traditional role of universities as providers of knowledge is greatly challenged. Rowley (2000, p. 120) remarks that universities must recognize and respond to their changing role in a knowledge-based society. They need to manage consciously and explicitly the processes associated with the creation of their knowledge assets, and to recognize the value of their intellectual capital to their continuing role in society.

These demands are addressed from different perspectives. For example, Kim (2010) considers the newer concepts related mainly to information and communication technologies advances as drivers of change, including developments like online education, blended learning, open educational resources, iTunes University, e-portfolios and so on. These have begun influencing certain functions in higher education. However, he considers that digital literacy no longer deals with word-processing or e-mailing proficiencies, but with competencies in rapid information searching and validating or in media organizing and presenting.

On their side, Staley & Trinkle (2011) refer to the changing landscape of higher education from another perspective. They state that in survey after survey corporate executives and heads of human resources departments say that they are looking to hire college graduates with well-developed writing, oral communication, interpersonal skills, and global cultural awareness and understanding, regardless of major. At the same time, these surveys suggest that employers have identified a deficit of these skills among college graduates. *"While many businesses understand the value of hiring liberal arts graduates,"* notes Roche, *"many hire business majors and then lament that their new employees lack the most important quality they seek: communication skills."*

For Garrison and Vaughan (2008, pp. 157, 172) the focus should be on technology to move universities towards the future. According to them, unlike most other large organizations, technology has had relatively little impact on higher education. The case is made by Duderstadt, Atkins, and Van Houweling (2002, p. 18 as cited in Garrison and Vaughan, 2008) who state, "*To date, the university stands apart, almost uniquely in its determination to moor itself to past traditions and practices*". The authors point out the limited, marginal use of learning technologies and then note the irony "*that the very institutions that played such a profound role in developing the digital technology now shaping our world are the most resistant to reshaping their activities to enable its effective use"*.

Students on the other side, assume that employers are interested only in their majors, and frequently dismiss their general education courses. Faculties, for their part, are loath to conceptualize their general education and liberal arts courses as career-preparation and skills-building endeavors. In other words, there are several disconnects between employers' stated preferences for graduates with the skills typically developed in the general curriculum, employers' commitment to hiring graduates who have demonstrated ability in these subjects, students' seriousness of purpose for their general education courses, and faculty's commitment to see general education in practical, vocational terms (Staley & Trinkle, 2011).

According to the same authors, "General education," or the core curriculum, is in many ways a vestige of the nineteenth-century common curriculum; the subjects, studied in fixed sequence that defined a college/university education for every student. The rise of

the elective system at the turn of the twentieth century meant that students could concentrate on a subject of their choice, which was a change that challenged the philosophy that all students should master a common set of subjects. General education was meant to maintain at least the spirit of that older curriculum, mandating classes that would provide all students with a broad grounding in a variety of subjects purposed to enable a generally educated person to work and live in the world. After World War II, as more and more students streamed into colleges and universities, the elective system became wedded more closely to post-graduation employment needs: students majored in a subject they expected to pursue as a career.

In the current globally-competitive, highly-dynamic environment, job preparation is even more important to students, and the general education curriculum can appear tangential to those needs. General education has been defined both as a curriculum for broadening the mind—one of the hallmarks of an educated person—and as a way to prepare for active participation as a citizen. Students, however, seem less persuaded by these goals and apparently are not hearing from employers that the skills developed in the core curriculum have value. Students are hearing that these courses are a hoop to jump through before getting to the "real" coursework that is more directly applicable to real-world career preparation. Some colleges and universities, responding to what they perceive to be students' lack of interest, deemphasize general education (*idem)*.

The Boyer Commission (2001 as cited in Garrison and Vaughan, 2008, p. 172) manifests clearly that in higher education, for the most part of them, fundamental change has been shunned; universities have opted for cosmetic surgery when radical reconstruction is called for. Higher education institutions have yet to fully recognize the transformative impact and potential of communication and internet technologies to concurrently address pedagogical and budget shortfalls.

Just as an example, Rama (2005) says that a dilemma for higher education, which is becoming increasingly complex with the development of the knowledge and information society, is that universities should not deliver knowledge with short validity or, even worse, emphasize evaluation in knowledge that are quickly becoming obsolete.

Moreover, it is high time that higher education institutions recognize that holding onto past practices that are incongruent with the needs and demands of a knowledge society

is an untenable position. Higher education leaders have the challenge to position their institutions for the twenty-first century (Garrison & Vaughan, 2008, p. ix).

The concept of learning throughout life thus emerges as one of the keys to the twenty-first century. It goes beyond the traditional distinction between initial and continuing education to meet the challenges posed by a rapidly changing world. This is not a new insight; previous reports on education have emphasized the need for people to return to education in order to deal with new situations arising in their personal and working lives. That need is becoming stronger. The only way of satisfying it is for each individual to learn how to learn (Delors, 1998, p. 20). This report places education on four pillars: learning to know, learning to do, learning to live together, and learning to be.

Nowadays, educational institutions cannot continue with the same comprehension of education. They have to re-set the learning–teaching process and remove the rooted learn culture from its pre-Gutenberg approach (Arnold, 2012a, p. 1). New learning culture will only be possible in a sustainable way if the responsible stakeholders respond with a self-reflective attitude, and are open (and want) to change without defending long-established experience and routines (Arnold, 2012b, p. 1).

In the case of Latin America, important initiatives regarding the future of higher education have been set forth as presented in the following section. Notwithstanding, many problems persist, and there is a need to give a higher priority to higher education. Programs are often of low quality and relevance, and talent is underused due to considerable inequities. Widespread inefficiencies reduce the return on the use of scarce resources. The lack of credit transfer mechanisms impedes national and international mobility, and as a result the region falls far short of building a critical mass of researchers of international repute (Holm-Nielsen, Thorn, Brunner, & Balán, 2005).

BACK TO THE FUTURE

The future of higher education is an issue of international concern. All around the world conferences, seminars, workshops, and discussion tables have taken place to analyze the present and to foresee the future of higher education. To mention some selected examples, in the United Kingdom in 2003, the document “The future of higher education” was presented to Parliament by the Secretary of State for Education and Skills by Command of Her Majesty, which says challenges, are related to skills needs,

social class gap, best academics and stronger links with business and economy. For this, they identify as necessary elements lifelong learning, research, knowledge transfer, social inclusion and economic development (Secretary of State for Education and Skills, 2003). Conclusions in this paper are related to stimulating higher quality in teaching, research, knowledge transfer; widening participation, along with economic and cultural impact; fair access for students from all backgrounds; improving innovation; welcoming changes related to new forms of cooperation; investing in even more effective leadership and management; and to continue to embodying the values which are central to a democratic society (*idem* p. 101).

On a wider level, in 2004 the Conference "The Europe of Knowledge 2020: a vision for university-based research and innovation" took place in Liège, Belgium. This was a reflection space where universities where considered essential actors in the knowledge society (as well in research and science). Importantly, the conference was focused on issues related to knowledge production, university-industry relation, interdisciplinary research, higher education and research, changing environments and new demands, universities driving regional development, university autonomy and governance, among others. Some remarkable results and recommendations of this conference are presented below (see Blythe, Hasewend, & Laget, 2004) because of their relevance to the topic of this thesis (they were also suggested by Honduran experts, see **Results** and **Discussion** section):

- To invest in training researchers
- Encourage interdisciplinary cooperation
- Make universities more accessible
- Emphasis on cooperation between developing and developed countries
- Consolidation of European networks of knowledge transfer
- Consider inter and trans-disciplinarity more efficient at contributing to excellence and innovation
- Explore differences and similarities between hard science and social sciences/humanities
- To better characterize core competencies
- To train teachers to qualify them as higher education teachers
- To insure the inclusion of context dependent knowledge

- To reduce the gap, since knowledge production disparities are greater than regional income disparities

Furthermore, the international concern is evident through some transnational collaborative studies. This is the case in Tendencias 2020: Estudio de Prospectiva (Trends 2020: Study of Prospective), a study that intended to take a general look at the field of higher education to identify what is going on. It helped identify trends through a Delphi study with European and Latin American experts (OCU, 2010). Some relevant conclusions of this study are as follows:

- There is coherence between experts beyond their geographical distance; however there are also some differences, e.g. the interest of Latin American experts to develop transversal axes approach, as well as skills approach, while European experts are not absolute convinced about that.
- Information and Communication Technologies will be enhanced to attend "Native digital" students and their demand for more flexibility and lifelong learning.
- There should be a focus on integral education, where knowledge remain important but even more important are skills and competencies development.
- Research in the future will be based in cooperation, networking and open knowledge management systems.
- Critical factors to allow change are: leadership skills in university authorities, in Latin America to strengthen competencies in lecturers, researchers and administrative personnel; attitude face to change; financial factors to be up to date to technology.
- Both collectives agree that lecturers' skills are a critical factor, but this concern is more notorious in Latin America.
- More self-learning on the student side, and progressive transformation of teaching to tutorial function and skills development.
- Society representatives should have more presence in the management of universities, without losing the autonomous character.
- Evolution of a new model, to a university without barriers, open and transcultural.

Another study conducted by representatives of Australia, USA, UK and Netherlands states that higher education's purpose is to equip students for success in life - in the workplace, in communities, and in their personal lives. While this purpose may have remained constant for centuries, the world around colleges and universities is undergoing significant change. Higher education is under pressure to meet greater expectations, whether for student numbers, educational preparation, workforce needs, or economic development. New models, an intense focus on the student experience, and a drive for innovation and entrepreneurism will ensure that higher education continues to meet society's needs. Creating this future will require collaboration across organizational and national boundaries, bringing together the collective intelligence of people from different backgrounds including education, corporate and government (CAUDIT, 2010, p. 12).

Nicholson (1998, p. 726) states that in the year 2030, students do not attend lectures, take test, or experiment in laboratories once admitted to a higher education institution (Experience Camp type, one of two foreseen types). They are not graded for their work. The curriculum consists of independent study at each student's discretion (with approval of their primary teacher-mentor). Academic content is drawn directly from a service activity, which is working in the community under the supervision of licensed mentors and non-profit organization leaders.

Tapscott & Williams (Tapscott & Williams, 2010, p. 1) point out that the transformation of the university is not just a good idea, but an imperative. Evidence is mounting that the consequences of further delay may be dire. To remedy this, change is required in two vast and interwoven domains that permeate the deep structures and operating model of the university: (1) the value created for the main customers of the university (the students); and (2) the model of production for how that value is created. First we need to toss out the old industrial model of pedagogy (how learning is accomplished) and replace it with a new model called collaborative learning. Second we need an entirely new *modus operandi* for how the subject matter, course materials, texts, written and spoken word, and other media (the content of higher education) are created. We need a collaborative knowledge production. In the same direction is the contribution of Brown and Adler (2008, p. 18) who argue in favor of social learning as the best model for the

future of higher education. Knight (2005, p. 32) presents the international dimension as a trend for the future in higher education.

Following Delors (1998, pp. 25-26) universities of the twenty first century should be vested in them four key functions:

- To prepare students for research and teaching.
- To provide highly specialized training courses adapted to the needs of economic and social life.
- To be open to all, so as to cater for the many aspects of lifelong education in the widest sense.
- International co-operation.

In this way, universities would transcend what is wrongly held to be the conflict between the logic of public service and the logic of the job market. They would also reclaim their intellectual and social vocation as, in a sense, guarantors of universal values and the cultural heritage. These are cogent reasons for urging greater university autonomy.

Undoubtedly, the future of higher education will involve change. But, what should we change and what should we hold on to in the coming future of higher education? This question was posed by Oblinger (2010, p. 4) in her article Timeless Fundamentals: Changing the Future of Higher Education. She quoted Sanger (co-founder of Wikipedia) who says … a good education is … *to develop judgment or understanding of questions that require a nuanced grasp of the various facts and to thereby develop the ability to think about and use those facts.*

Education and its problems, needs, and challenges are a concern of society and all fields of knowledge have something to say about it. UNESCO published in 1998 the World Declaration on Higher Education in The Twenty-First Century: Vision and Action based on the World Conference on Higher Education. The Conference was unanimous in considering that a renewal of higher education is essential for the whole of society to be able to face up to the challenges of the twenty-first century, to ensure its intellectual independence, to create and advance knowledge, and to educate and train responsible, enlightened citizens and qualified specialists, without whom no nation can progress economically, socially, culturally or politically.

As the Declaration of the World Conference emphasizes, because society is "increasingly knowledge-based (...), higher education and research now act as essential components of cultural, socio-economic and environmentally sustainable development of individuals, communities and nations." The development of higher education must therefore feature among the highest national priorities.

It is now clear that, to fulfill its mission, higher education must change radically, by becoming organically flexible and at the same time more diverse in its institutions, its structures, its curricula, and the nature and forms of its programs and delivery systems, and by mastering the information technologies which can help it achieve its purpose. Higher education must anticipate the developing needs of society and individuals, and it must be open to the needs of adults for continuing education and the updating of their knowledge and skills, whether in the pursuit of retraining, redeployment or cultural improvement in general. In short, higher education in the twenty-first century must be seen to be part of the global project of continuing education for all, it must become the motivating force of that project, the place where it all happens, and it must help to integrate into that project all other levels and forms of education by strengthening its links with them (see UNESCO, 1998).

One year later, Morin (1999) wrote for UNESCO "Seven complex lessons in education for the future" from a philosophical perspective that could be resumed as follows:

1. Detecting error and illusion
    - The purpose of education is to transmit knowledge, and yet education is blind to the realities of human knowledge, its systems, infirmities, difficulties, and its propensity to error and illusion. Education does not bother to teach what knowledge is.
    - Knowledge cannot be handled like a ready-made tool that can be used without studying its nature. Knowing about knowledge should figure as a primary requirement to prepare the mind to confront the constant threat of error and illusion.
    - We must introduce and develop the study of the cultural, intellectual, and cerebral properties of human knowledge, its processes and modalities.
2. Principles of a pertinent knowledge
    - How can we encourage a way of learning that is able to grasp general, fundamental problems and insert partial, circumscribed knowledge within them.

- The predominance of fragmented learning divided up into disciplines often makes us unable to connect parts and wholes.
- We should develop the natural aptitude of the human mind to place all information within a context and an entity.

3. Teaching the human condition

- Humans are physical, biological, psychological, cultural, social, historical beings. This complex unity of human nature has been disintegrated by education divided into disciplines, that we can no longer learn what human being means.
- The human condition should be an essential subject of all education.
- How we can assemble and organize knowledge dispersed in the natural sciences, social sciences, literature, and philosophy, to demonstrate the connection between the unity and the diversity of all that is human.

4. Earth identity

- The future of the human genre is now situated on a planetary scale. This should become a major subject. Knowledge of current planetary developments and recognition of our earth citizenship, will be indispensable for all of us.
- We should show how all parts of the world have become interdependent.
- The complex configuration of planetary crisis in the 20th century should be elucidated to show how all human beings now face the same life and death problems and share the same fate.

5. Confronting uncertainties

- We have acquired many certainties through science but 20th century science has also revealed many areas of uncertainty. Education should include the study of uncertainties that have emerged in the different fields of sciences.
- We should teach strategic principles for dealing with chance, the unexpected and uncertain, and ways to modify these strategies in response to continuing acquisition of new information.
- "The expected does not occur and [the gods] open the door for the unexpected." These lines, composed more than 25 centuries ago by the Greek poet Euripides, are more than ever relevant. Every person who takes on educational responsibilities must be ready to go to the forward posts of uncertainty in our times.

6. Understanding each other

- Understanding is both a means and an end of human communication. And yet we do not teach understanding. Our planet calls for mutual understanding in all directions. Given the importance of teaching understanding on all educational levels at all ages,

the development of this quality requires a reform of mentalities. This should be the task of education for the future.

- Misunderstanding must be studied in its sources, modalities, and effects. This is all the more necessary in that it bears on the causes instead of the symptoms of racism, xenophobia, discrimination. And improved understanding would form a solid base for the education for-peace.

7. Ethics of the human genre

- Education should lead to an "anthropo-ethics" through recognition of the ternary quality of the human condition: a human being is an individual ↔ society ↔ species.
- Ethics cannot be taught by moral lessons. It must take shape in people's minds through awareness that a human being is at one and the same time an individual, a member of a society, a member of a species. All truly human development must include joint development of individual autonomy, community participation, and awareness of belonging to the human species.

BRIEF COMPARISON BETWEEN EUROPEAN AND LATIN AMERICAN UNIVERSITIES

In order to make the situations comparable, a brief update regarding higher education in both Latin America and Europe is presented in this section. However, is impossible to have an objective comparison because, in Europe decisions about the present and the future of higher education take place on the level of the European Union, while in Latin America decisions are taken in the national level if lucky, or in the institutional level. Latin America does not have strategies or agreements to have a common educational space like Europe does, as will be presented below.

Europe

In Europe, universities signed the *Magna Charta Universitatum* on the 900th anniversary of the University of Bologna in 1988. It is the final result of a proposal the University of Bologna addressed to the oldest European Universities in 1986. It confirms the autonomy and freedom of the university. This document aims to celebrate the deepest values of University traditions, and to encourage strong bonds among European universities (any extra-European University has the possibility to join as well) (Observatory Charta Magna Universitatum). Since then, Europe has been in the process of enacting significant reforms in higher education. The most well-known is the Bologna Process, which took place in 1999. The aim of this reform was to create a common space

of higher education to ensure comparability in the standards and quality of higher education qualifications. In the years since, many new educational acts have been passed. The most notable relates to quality assurance and accreditation systems, which have been major reform themes in many European countries.

In 1999 the President of the Confederation of European Union Rector's Conferences stated: *" … but we should not forget that Europe - and this is different compared with "those times" of the middle age - is no longer the self-sufficient economic and cultural center of the world. On one side we are on international level again communicating in one language. But on the other side we are living in a time in which global views, actions and challenges enhanced by modern ICT are dominating and demanding every effort of institutions of higher education - though locally based - to stay or become able to compete in a worldwide scenario. This competition does not only take place in research thus seeing the institutions competing worldwide for professors or young researchers and resources. To be able to compete is also necessary in teaching for several reasons"* (Erichsen, 1999).

European higher education institutions are aware that today's universities operate in a competitive international environment that is affecting both their teaching and research missions. According to the European University Association, this is no longer a major concern for only a small number of elite institutions, but a reality for the broad spectrum of European universities. Governments see universities as key actors in the globalization of higher education and research, which they consider important for national and regional competitiveness and prosperity. This is also reflected in the elaboration of international strategies for higher education and research at both national and European level (European University Association).

Higher education systems play a crucial role in the creation of the knowledge that underpins human and societal development, as well as the promotion of active citizenship. Europe developed the Modernisation Agenda of Higher Education, giving special consideration to a few core principles. First, the need for more highly skilled, knowledgeable, and innovative people in order to allow their economy to keep up with competitors. The list of competitors includes emerging economies like China, where higher education is expanding rapidly. To meet this goal, they set a target declaring 40% of 30-34 year olds should have a degree by 2020. Second, greater access to higher

education will improve people's job prospects at the individual level. Third, Europe needs a broader range of higher education institutions to meet the needs of a larger and more diverse group of students, and to ensure there are enough highly qualified, forward-looking people in every sector of the economy and across society. Fourth, institutions need to specialize more; currently, they try to compete in too many areas at the same time, limiting their ability to become 'world class' in any individually (European Comission).

The main areas for reform identified in the new agenda are (see European Comission, 2011):

- To increase the number of higher education graduates
- To improve the quality and relevance of teaching and researcher training, and to equip graduates with the knowledge and core transferable competences they need to succeed in high-skill occupations
- To provide more opportunities for students to gain additional skills through study or training abroad, and to encourage cross-border co-operation to boost higher education performance
- To strengthen the "knowledge triangle", linking education, research and business
- To create effective governance and funding mechanisms in support of excellence.

Moving to a new learning paradigm based on skills and competencies is the most relevant change in the international image of European higher education of the last ten years. This change was triggered by the Bologna Process. However, for many experts, there is still much today for the reform to reach classrooms (see connoted exponents Arnold, Erpenbeck, Hartman, Schaper, Forneck, Schwarze in (BMBF and ESEU, 2012). It is also important to mention that higher education in Europe is deeply concerned about the role of universities in lifelong learning. During the meeting entitled Studium 2020: Positionen und Perspektiven, well-known experts on the field of higher education presented the needs and trends of higher education in Germany. Some elements, such as diversity and individualization (Meyer-Guckel), new learning concepts (Arnold), internationalization (Kerres), new didactic concepts (Schulmeister), the role of emotions (Erpenbeck; Wilkesmann), flexibilisation (Hanft) were relevant during the presentations and discussions (Stifterverband für die Deutsche Wissenschaft, 2012).

Other studies remark the necessity to improve governance and research. Autonomy is, for example, one important issue. Institutional autonomy across Europe has grown in recent years, creating opportunities for public universities to act more as integrated organizations, and to determine their own profiles and strategies. Germany in this context has moved from a low-medium level of autonomy in 1995 to a medium-high level in 2008. However, universities claim for an even higher level of autonomy (CHEPS; INCHER; NIFU/STEP;Institute of Education; Technopolis, 2009). Research as one of the important mission of universities, has been heavily discussed in order to keep Europe the most competitive knowledge-based society in the world (see section Back to the Future in this same Chapter).

Latin America

From a regional perspective, the complexity of higher education, both now and in the future, can be viewed in a series of historical and emerging trends, in its heterogeneity, its inequality, but above all in the role that public universities and some very outstanding institutions of higher education can assume in order to construct a new scenario that can aid to a significant improvement in the living conditions of its populations, and provide the possibility of greater well-being, democracy, and equality coming from science, education, and culture (Didriksson, 2008, p. 21). The impact of higher education situation is dramatic if we consider that, while Latin America represents 8% of the total world population, it could boast only 1.6% of world scientific publications, 0.2% of patents, and 0.2% of applied knowledge (*idem* p.26).

In a context of changes and continuities, what are the principal factors molding the possible futures of Latin American Higher Education? A most fundamental change is surely the new economic role of knowledge that greatly affects universities in developed and underdeveloped landscapes, although in different ways (Arocena & Sutz, 2005, p. 580).

Arocena (*idem* p. 581) cited Gibbons et al. (1994) who says that such factors are closely connected with the academic transformations that have been characterized as the emergence of a 'new mode of production of knowledge', in which universities as such will lose centrality as sites for creation of knowledge. Zimann (1994 as cited in Arocena, 2005) says that in any case, the traditional academic way of life has changed so much

that perhaps someone who has been absent for a couple of decades would scarcely recognize it.

Consequently, it can be said that actual processes in Latin American Higher Education are shaped by at least two main tensions: A worldwide tension between the internal university dynamics and the emerging type of external relations, and a regionally specific tension between two notions of external involvement, one sanctioned by the tradition of the URM and the other one fostered by the rise of a new set of market-dominated relations with governments and entrepreneurs (*idem*, p. 582).

There have been some initiatives to change and improve higher education in Latin America. However, a conclusion presented in a UNESCO report is as follows: "*There are a wide variety of Higher Education system reform processes underway in the region. But although these are positive, they are still far from signaling an in-depth transformation of Higher Education in the region. The agendas of change proposals refer, in the best of cases, to: forms of the university; information and communication technologies; structure and operation; assessment and accreditation processes; personnel development; student performance; and forms of university financing. But the organization of knowledge, institutional profiles, epistemological frameworks, and their translation into organizational forms for faculties, schools or courses, do not even appear in the declarations and foundations of the proposed reforms. The reforms in course are not reforms in the way of thinking; rather, they are technical adjustments guided toward responding functionally to different demands. Thus, Latin American and Caribbean Universities today face strong dilemmas, trends, and challenges that they must solve, consider and confront*" (Lanz, Fergusson, & Marcuzzi, 2006, p. 110).

Therefore, the emphasis on a new reform of Higher Education should design and put into practice a new Latin American (and Caribbean) learning-centered paradigm, and a new and innovative model of academic offerings; offerings that can provide the broadest range of scientific, technological, and humanistic experiences that makes possible a quality leap in social responsibility and in the commitment of the institutions of Higher Education of the region. This paradigm depends on the institutions transforming themselves into permanent learning organizations in which innovation constitutes the key to a new academic culture (Didriksson, 2008, p. 32).

In this regard, there are three processes that should be carried out in order to break with traditional, reproductive, and technical-functional traditions (*idem* p.33):

- Curricular development based on cross-cutting themes and fostering of values. This process involves the integration of multiple learning environments, from normal classroom to on-line, that take advantage of all of the possibilities of an individual or of his or her social group to learn at a high level.
- Mobility of students and academics based on flexible programs. This process carries with it significant changes in university organization because it generates systems that lead to maximum use of collective learning and of networks.
- Re-dimensioning of disciplines to focus on problems and on the new areas of modern knowledge.

In contrast with the experience of Europe and its common space of higher education, the project Tuning was implemented in Latin America (similar to the one conducted in Europe with 175 universities as a response to the challenge set out in the Bologna Declaration). It was created in a context of deep reflection on higher education, at both a regional and an international level. The main difference between both context, is that Latin America has not set itself a date for building a higher education area, nor does it have a clearly agreed political framework such as that which exist in Europe. The Tuning Latin America does not seek to create such an area, but would like to offer elements that will facilitate reflection in order to reach certain basic agreements within the framework of higher education (Benetione, Esquetini, González, Maletá, Siufi, & Wagenaar, 2007, pp. 18-19).

This report presents the following challenges accepted by the Latin American universities (*idem* p. 20-22):

a) A new production factor, based on knowledge and proper use of information.
b) New information and communication technology.
c) A new concept of the professional profile, with critical thinking, with a profound knowledge of local and global realities and in addition the capability to adapt to change. Student learning should be multi and interdisciplinary.

d) Teaching must concede centered stage to student learning, to move from teaching-centered education to learning-centered education.
e) The global scale of human activities and the necessity to be able to share degree courses, study programs and curricula with other universities.

This project leaves a feeling of willingness to design together a shared philosophy that will foster the comparability and compatibility of higher education systems in Latin America. The challenge that still remains is to consolidate existing bridges and build new paths to understanding at regional and international level.

THE NATIONAL CONTEXT - HONDURAS

The present and the future of higher education is highly context specific; especially in Latin America, where, as stated before, policies and plans are made on the national or institutional basis. In this particular research, the experts' opinion was influenced by the current socio-economic and political situation. Therefore, a country brief, in some cases a comparison with Germany (where this thesis was conducted), is presented below as a reference for a better comprehension of the situation. As an overview, Table No. 1 presents the more relevant parameters of both countries.

Table No. 1 *Brief comparison of main parameters for Germany and Honduras*
(Sources: World Bank, 2012; German Rectors' Conference, 2011; UNESCO, 2012)

Parameter	Germany	Honduras
Surface (sq.km.)	356,733	112,492
Population (millions)	80	7,9
Population density (ppsk)	228,2	68,2
Life expectancy (years)	82,4/77,1	74,5/69,8
Gross National Income ($ per capita)	43290	3750
Human Development Index	10 (0,885)	109 (0,732)
Category	Very high human development	Medium human development
Higher Education Institutions	379	20

Geography

Geographically Honduras is located at the heart of Central America, with shores on both the Pacific and Atlantic oceans. Honduras borders three countries: Guatemala and El Salvador to the west, and Nicaragua to the southeast. It is the most mountainous country in Central America, and yet the only one without any active volcanoes. Additionally, the Bay Islands of Honduras enjoy a privileged geographic location that puts them on the south-eastern end of the great Meso-American Barrier Reef, the most bio diverse barrier reef in the World.

Honduras covers 112,492 square kilometers, with this surface it is the second largest country in Central America.

Figure No. 1 *Geographical position of Honduras*
(Source: http://students.cis.uab.edu/idm92/hondurasmap.jpg)

Population

Honduras has a total population of 7,754,687 people (World Bank, 2012). Spanish is the national language, but there are a few dialects that are spoken by various ethnic groups living in Honduras. The country of Honduras is home to people of various ancestries. The Garifuna communities (known in Europe as the Black Caribs) are found on the islands and along the Caribbean coast. The ancient Mayans left the Copan Ruins, an archaeological site considered one of the most artistically advanced and detailed of all Mayan cities. The modern Maya, known as the Chortí Indians, can still be found nearby. The Miskito Indians who habit in the Biosphere Reserve of Rio Plátano, a declared World Heritage by UNESCO. Other ethnic groups include the Lenca, Pech, Tolupan (Jicaque), and Tawahka Indians (Honduras, 2012).

From a demographic point of view, Honduras has an increasing population with a majority of people under 19 years old.

Figure No. 2 *Population distribution in Honduras*
Source: (CEPAL, 2000-2011)

Economy

The Honduran economy has managed to diversify itself in the past 20 years. Back in the early 1900s, Honduras was known as the original Banana Republic and was the largest producer and exporter of bananas in the world. During the 1990s, tax incentives made the country an attractive place for investment in bond manufacturing (maquiladoras). The country became competitive with Mexico and many international manufacturers, including Korea, Taiwan, Pakistan, and USA. These bond manufacturing enterprises have

become the largest year round employers in the country. Additionally, the Republic has become a huge supplier of quality coffee worldwide. Being the fifth-largest world producer of coffee, Honduras produces and exports more coffee than any one of Central American countries. Another major product is African Palm oil, which is widely used to produce vegetable oil, soaps, and other related goods. It also has large plantations that produce watermelon and cantaloupe for export.

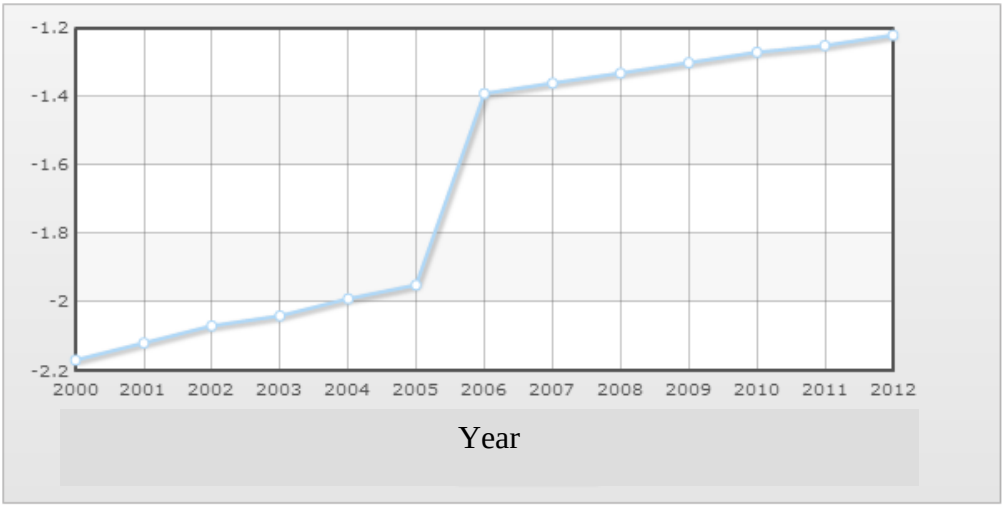
Honduras is a lower middle-income country with a huge wealth gap and a history of military rule and corruption. Over 59% of Hondurans remain below the poverty line and 36.2% below the extreme poverty line.

The country has a diversified economy based on the international commerce of agricultural products and manufacture, which makes it the most open economy of Central America: the sum total of its imports and exports represented 129% of its Gross Domestic Product (GDP) in 2008 (World Bank, 2012).

Hurricane Mitch aggravated dire poverty in 1998. After this massive loss of life and assets, Honduras embarked on a very ambitious Poverty Reduction Strategy (PRS) in consultation with civil society and donors, agreeing to a set of actions aimed at reducing the incidence of extreme poverty by half by 2015.

The Country Assistance Strategy (CAS) supported the PRS by contributing to the restoration of macro-economic stability, improvement of the business climate, better performance of the financial sector, and a sound framework for public sector financial management.

Growth in Honduras is largely attributable to the continued growth in remittances and strong export performance, particularly by the “maquila” sector and by the CAFTA effect on private investment. Such relevance from remittances says that Honduras has also a great emigration rate, mainly to the United States of America (see Figure No. 3).



Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Honduras	-2,17	-2,12	-2,07	-2,04	-1,99	-1,95	-1,39	-1,36	-1,33	-1,3	-1,27	-1,25	-1,22

Figure No. 3 *Net migration rate in Honduras*
Source: (http://www.indexmundi.com/g/g.aspx?c=ho&v=27&l=es)

Government

Officially independent from Spain since the 15th of September, 1821, Honduras will soon celebrate 200 years of independence. Politically, it has a democratic government with three distinct and separate powers: the executive branch, headed by an elected president that cannot be re-elected; the legislative branch, headed by a congress or Chamber of Deputies; and a judicial branch, which is formed by a team of 15 judges that are elected by Congress every 7 years.

The country is divided into 18 departments, and each of them has a series of municipalities, that are run by mayors.

The Honduran elections take place every four years. Since 1982, there have been a total of eight electoral events, during which Hondurans elected their president, the 128 congresspersons, and 298 city mayors. Power has alternated between the two major parties, national and liberal. The last election took place on Sunday, the 27th of November 2009, in accordance to the Honduran constitution that defines Election Day as the last Sunday in November, every four years.

The following information has been retrieved from the World Bank website: *On the political side, it is a relatively young democracy which left behind a series of past military regimes and has experienced eight consecutive democratic election processes since 1982.*

Drug trafficking and crime are fueled by poverty and rising unemployment. Youth gangs, known as "maras" have plagued Honduran society to the point of becoming a major security issue.

The World Bank has worked with the government to design a support program to help Honduras deal with its development challenges. The current administration prepared a National Plan with four objectives:

1. *A Honduras with no extreme poverty, educated and healthy, with consolidated systems of social security.*
2. *A country which develops within a democracy, with safety and without violence.*
3. *A productive Honduras, which creates opportunities and worthy jobs, harnessing its resources in a sustainable fashion and reducing the vulnerability of the environment.*
4. *A modern State, transparent, responsible, efficient and competitive.*

Education

In 2004, the average length of schooling was 4.1 years in rural areas, and 6.88 years in urban areas. The coverage in preschool education (38.8%) and basic (89.8%) is moving towards universal but there are still problems of quality and equity. This is due to the inadequate skills of teachers, lack of teaching materials and infrastructure, the limited involvement of the communities and the difficulty of applying the basic curriculum in rural and indigenous (PNUD, 2010). Honduras has also made progress in coverage of the higher education level (Fundación para la Educación Ricardo Ernesto Maduro Andreu, 2010, p. 8). This is reflected through a growing demand for public universities and the increasing creation of private universities. The gross rate of 17% to 2009 places the country in a situation similar to that of Guatemala, but below other Central American countries reporting coverage over 30% and up to 40% (UNESCO, 2009a, as cited in the same report). That is, despite the progress, there are major challenges at this level.

The structure of the educational system is presented in Figure No. 4, below:

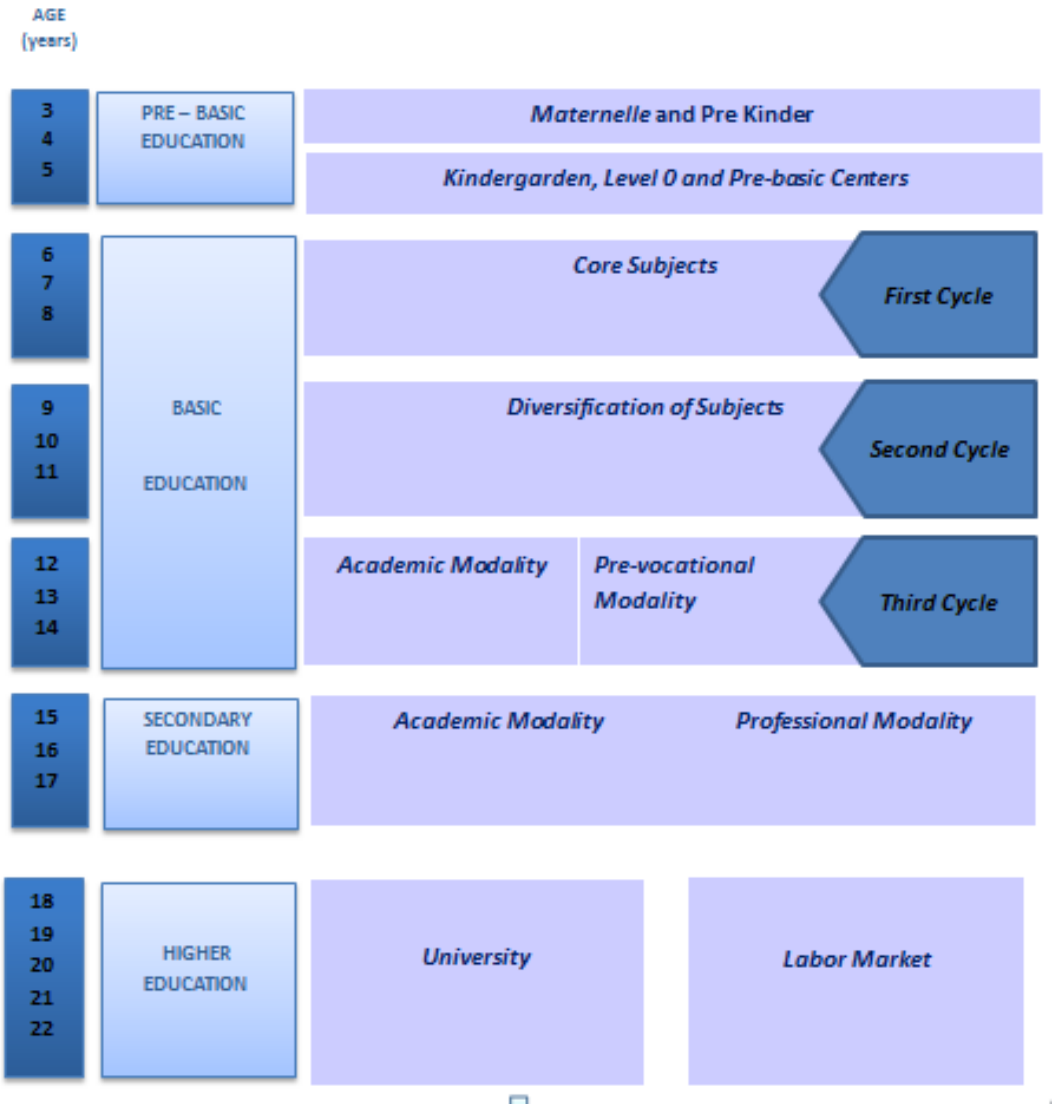


Figure No. 4 *Structure of Educational System in Honduras*
Adapted from: (Secretaría de Educación, 2003)

Coverage of education varies according to the level and in general decrease proportionally to the increasing level as we can see in Figure No. 5.

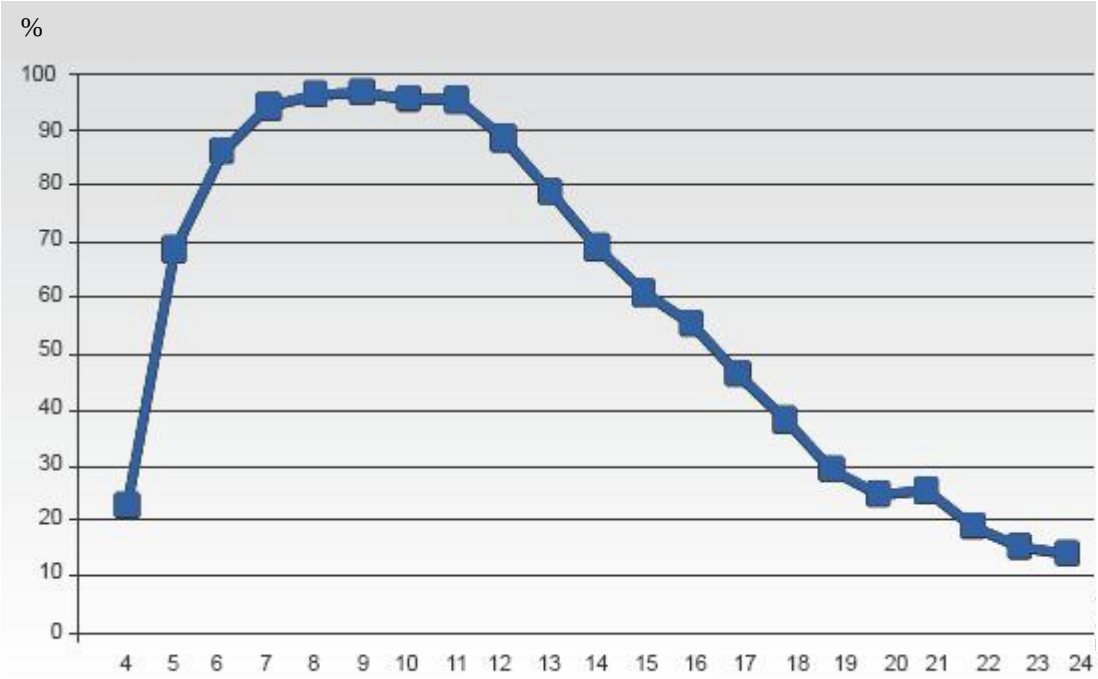


Figure No. 5 *Coverage of education according to age*
Source: (Fundación para la Educación Ricardo Ernesto Maduro Andreu, 2010, p. 9)

Honduras is one of the countries with the highest gender disparities in secondary school participation, 60% of boys aged 15 to 17 were engaged in economic activity in 2002 compared with 21% of girls. About 82% of the boys engaged in economic activity were not in school, compared with 61% of the girls (UNESCO, 2012, p. 116).

In many countries, the percentage of teachers trained according to national standards is low. Of 100 countries with data, 33 have less than 75% of their primary school teachers trained, and in 12 the share is less than 50%; among them are Benin, Ethiopia, Honduras, Liberia, Mali and Sierra Leone (UNESCO, 2012, p. 123).

Access to education is strongly related to the economic possibilities of population as we can see in Figure No. 6.

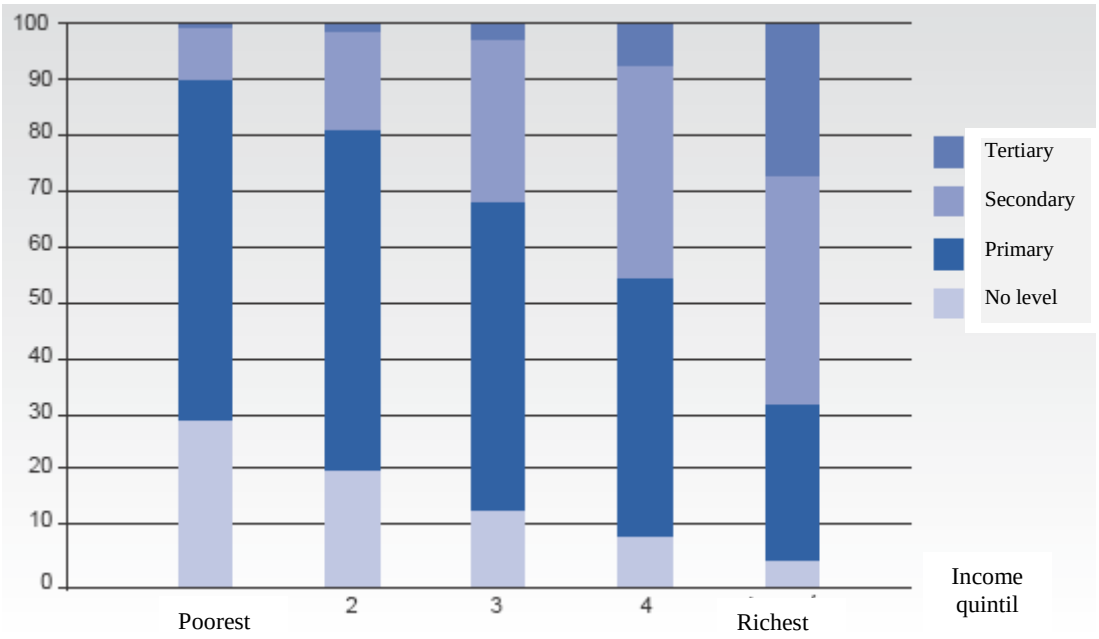


Figure No. 6 *Access to education in relation to incomes*
Source: (Fundación para la Educación Ricardo Ernesto Maduro Andreu, 2010, p. 17)

Higher Education

In Honduras the first University, Universidad Nacional Autónoma de Honduras (UNAH), was created in 1847. This University enjoys full autonomy in regulating itself in the framework of the Constitution and its organic law. Moreover, Article 160 of the Constitution of the Republic gives the National University, as an autonomous body decentralized from the State, the responsibility for approving, organizing, managing and developing higher and professional education in the country. This constitutional provision is developed by the Higher Education Act of 1989. According to this Act, higher education is managed by the Higher Education Council, which consists of 14 members, 8 of whom are appointed by the National University. This Council is chaired by the Rector of the National University and has an executive body, the Direction of Higher Education, which is appointed by the full faculty of the University. In this case, theoretically there is a single national system of higher education regulated by the Higher Education Act and headed by a single national body (the Higher Education Council). However, in practice, there are two subsystems, the National University on the

one side and the rest of the institutions (public and private), in the other. In either case the Ministry of Education is not involved in the regulation of higher education. The UNAH, through the Higher Education Council as a body of leadership and decision, issued the Academic Standards of Higher Education in order to regulate the development of higher education in the country. These standards provide a philosophical, conceptual and methodological framework, and define the general standards that higher education institutions must accomplish. However, standards are not related to accreditation requirement, since until very recently Honduras did not have an initiative for the establishment of a national system for accreditation.

The Vision of Country 2038

In 2010, for the first time Honduras created and published a Vision of Country (see Visión de Pais 2010 - 2038, 2010), a document that entails strategic principles, objectives, goals and guidelines that should be reached in seven consecutive leadership turnovers, from 2010 to 2038. By then a population of 13 million is expected with an average age around 30 years (from 7 million and 19 years old in 2007). A process of social and economic consolidation, capable of offer opportunities to hundreds of thousands of young people, who will require education, vocational training, entrepreneurship capabilities, and personal expectations, has begun with this document.

Principles guiding the required development includes, among others:

1. Focus on the human being and equitable-integral development
2. Respect for the dignity of the human person
3. Solidarity and equity as criteria for state intervention
4. Subsidiarity as state policy
5. Freedom as part of human development
6. Human development as a process generates opportunities
7. Gender equality as a transversal axis
8. Respect and preservation of the culture of Ethnic Groups
9. Integrity and transparency as the basis of the action
10. Sustainable development in harmony with nature

Objectives are clustered in four groups:

1. A Honduras without extreme poverty, educated and healthy, with consolidated social welfare systems
2. A Honduras taking place in democracy, safely and without violence
3. A productive Honduras, generating opportunities and decent jobs, sustainable way that leverages its resources and reduce environmental vulnerability
4. A modern, accountable, efficient and competitive

According to this plan, regarding higher education …

… by the year 2022 … The universities have become centers of academic excellence, teaching quality certified according to international standards and will contribute to the growth and modernization of the national productive through effective technology transfer.

… by the year 2038 … Honduras will have an efficient education system, skills generator, capable of promoting sustainable processes of social emancipation and where flexibility and adaptation of the curricular basis at all levels, will allow the Honduran reach the full potential of material, cultural and spiritual development. The new education system will ensure that all Hondurans have access to optimal levels of individual and social welfare.

Chapter III - BIOLOGY OF KNOWLEDGE: potential contributions to higher education

> *Whatever we do in every domain, whether concrete (walking) or abstract (philosophical reflection), involves us totally in the body … Everything we do is a structural dance in the choreography of existence. (Maturana and Varela, 1987)*

The discussion about the "right" comprehension of knowledge has had a long tradition. It is remarkable that one generation after another has thought deeply about the concept "knowledge". These efforts, initiatives, approaches, and results are all perfectly consistent analytically. Even so, no one has been able to dispel all the doubts about the definition and interpretation of this term, and, as such, there has not been a renewed understanding of knowledge or a knowledge concept presented (Broßmann & Mödinger, 2011, pp. 9-10). For the purposes of this research, therefore, it is not necessary try to add another definition of knowledge, or another approach. Instead, this section will begin with an overview of the discussion related to the topic, and the different points of view in order to adopt the appropriate one for the purpose at hand.

Several authors have attempted to define knowledge using metaphors. As Andriessen (2008, pp. 5-6) explains these authors have attributed the qualities of an object, a process, an asset, a resource or capital, and others to the concept of knowledge. Table No. 2 was presented by Alavi & Leidner (1999, p. 10) for the first time, and modified by Chen & Chen (2006, p. 19) in an attempt to summarize the different connotations attributed to this concept and its implications for knowledge management. This Table will be used later to analyze the use of the knowledge concept in higher education environments in Honduras, and how it influences the "knowledge activities" at universities.

Table No. 2 *Most common connotations attributed to concept "knowledge"*
(Source: Chen & Chen, 2006)

	Description	Implications for KM
State of mind	Knowledge is the state of knowing and understanding.	KM involves enhancing an individual's learning and understanding through the provision of information.
Object	Knowledge is an object to be stored and manipulated.	Key KM issue is building and managing knowledge stocks.
Process	Knowledge is a process of applying expertise.	KM focus is on knowledge flows and the process of creation, conversion, circulation and carrying out.
Access to information	Knowledge is a condition of access to information.	KM focus is organized access to, and retrieval of, content.
Capability	Knowledge is the potential to influence action.	KM is about building core competencies and understanding strategic know-how.

One aim of this research was to explore the uses and application of the knowledge concept by Honduran experts in higher education. By doing this, it intends to identify the implications of the meaning of knowledge for the practice of educational sciences in Honduran higher education institutions. To achieve this goal, the following sections present a recapitulation of the different uses and conceptions of knowledge, with emphasis on the biological meaning. The approach assumes that our understanding of the concept will also influence the ways of teaching and learning in higher education.

TYPES OF KNOWLEDGE

Because of the great range of meanings the knowledge concept can take on, it becomes convenient to categorize different types of knowledge. Table No. 3 attempts this categorization according to their use in the literature. As stated before, knowledge is sometimes referred as a human condition. Within this classification, it is possible to have a set of sub-classifications. When it is referred to as a human condition or as an object it is possible to find another set of categories. Yet, other times the categories are determined by the transition from being an object, external to the human condition, to something stored or processed somewhere and somehow in the human body.

Table No. 3 *Categorization of the concept "knowledge"*
(An abstract from the different uses identified in the literature)

According to ...		
	KNOWLEDGE AS A HUMAN CONDITION	
... the way to acquire it. (Hyman, 2012, p. 101)	**A priori** Is independent from any other experience, is a universal and necessary true.	**A posteriori** It derives from the sensorial experience. It is refutable.
... the source. (Hyman, 2012, p. 101)	**Empiric Knowledge** Is obtained through the experience.	**Propositional Knowledge** Is obtained through secondary sources.
... its state in the person's long term memory (Anderson, 1993)	**Declarative Knowledge** Consists of "knowing about"	**Procedural Knowledge** Consists of "knowing how"
... at what it is referred (Alavi & Leidner, 1999)	**Procedural Knowledge** A form of know-how **Conditional Knowledge** A form of know-when	**Causal Knowledge** A form of know-why **Relational Knowledge** A form of know-with
	KNOWLEDGE IN THE TRANSITION FROM AN OBJECT TO A HUMAN CONDITION OR VICEVERSA	
... the number of person who poses it. (Hyman, 2012, pp. 101-102)	**Social Knowledge** Written knowledge that as individual could be forgotten without losing it as collective knowledge.	**Individual Knowledge** Related to the cognitive function of every single person.
... the way of transference. (Nonaka & Takeuchi, 1995, pp. 8-9)	**Explicit Knowledge (Documented)** Can easily be "processed" by a computer, transmitted electronically, or stored in databases...	**Tacit Knowledge (Subjective)** Has an intuitive nature that makes it difficult to process or transmit the acquired knowledge in any systematic or logic manner.
... the form of retrieval (Alavi & Leidner, 1999)	**Conscious Knowledge** Similar to explicit, it comes intentionally to our minds	**Automatic Knowledge** It is show as an automatic response to situations in the form of actions mainly.
	KNOWLEDGE AS AN OBJECT	
... the way in which it is produced (Nowotny, Scott, & Gibbons, 2002, pp. 79-95)	**Mode 1** It is produced through scientific research.	**Mode 2** Is the way used currently in the knowledge society, where any single individual can contribute to a pool of information.

KNOWLEDGE VS. INFORMATION

Knowledge is frequently related to other concepts. Looking carefully at Table No. 2 and 3, it becomes necessary to examine the distinctions drawn between two related concepts, information and knowledge. Looking closer, some other related concepts appear e.g. data, intelligence, and wisdom. Attempts to define these concepts are numerous, and produce slightly different results depending on which discipline is looking at them.

According to Bouthillier & Shearer (2002), dictionaries define data as factual information (measurements or statistics) used as a basis for reasoning, discussion, or calculation; information as the communication or reception of knowledge; knowledge as the condition of knowing something gained through experience or the condition of apprehending truth or fact through reasoning; and intelligence as the ability to understand and to apply knowledge. For Meadow et al. (2000, as cited by the same authors), data refers to a "string of elementary symbols, such as digits or letters". As they point out, information "has no universally accepted meaning, but generally it carries the connotation of evaluated, validated or useful data". Knowledge, on the other hand, involves "a higher degree of certainty or validity than information" and "has the characteristic of information shared and agreed upon within a community". Intelligence, for these authors, is a form of information but it is also "a measure of reasoning capacity".

A conceptual overlap exists between all these terms; mainly between information and knowledge, which are frequently interchanged. Figure No. 7 shows a growing scale of knowledge following Auer (2003). The scale was completed for the purpose of this research with two elements: the cyclic transformation from information to knowledge (through the learning process) and viceversa, and the separation between what can be considered an object and what can be considered a biopsychological process. The first constitutes an informational approach and the second a cognitive approach. Each stair shows a condition, which can be upgraded to the next through some action. For example, data plus a semantic interpretation gives information; information can be transformed in knowledge when we use the first meaningful interpretation in context. The scale continues, step after step. For the purpose of this research, the focus will be placed on knowledge and information, because of the frequent use of both concepts in the context of higher education, and because learning is understood as the process of translating this object (information) into a human condition (knowledge and others).

Even though knowledge and information are used indistinctly, there are positions, like those stated by Stenmark (2001) and cited by Ras (2009, p. 37), that consider the usage of the term “knowledge” for information stored in a computer inappropriate. In this model, explicit knowledge is information, while tacit knowledge can only exist within people.

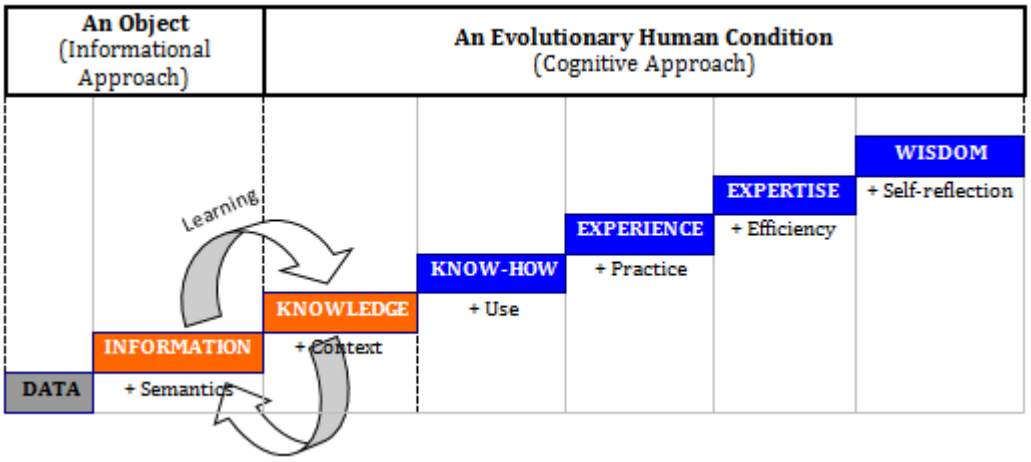


Figure No. 7 *Scale of "knowledge"*
It shows the transition from information (explicit knowledge) to knowledge (implicit knowledge)
Source: (Auer, 2003)

If we accept this scale as valid, is easy to understand the difference between knowledge and information. It is also possible to perceive a delicate line between both, and understand why they are found in the literature and common use as interchangeable concepts.

Finally, this thesis does not intend to solve the problem, or to find one solution to the diversity of knowledge connotations. To discuss the relative complexity of the knowledge concept is just a necessary step to understanding the scope of this thesis. The thesis is instead focused on how the meaning of the concept influences the educational process, and what would happen if knowledge is understood strictly as a human (animal) condition determined by social, psychological, and biological factors. Given that learning and the educational processes in general have been traditionally supported by the two first factors, this thesis introduces the biological approach of knowledge and its implications for education as presented in the following section.

THE BIOLOGICAL BASIS OF KNOWLEDGE

Traditionally, knowledge, or cognition, is counted among the 'higher' mental faculties opposite the conative or emotive ones (Glock, 2012, p. 557). It has been a topic of psychology, and has been separated from biological factors. However, the "**biology of knowledge"** is a concept developed by two biologists, Francisco Varela and Humberto Maturana. They stated, *"Knowledge is a process of "storing information" about the environment, and the process of living is therefore to know how "to adapt" to that environment acquiring more and more "information" about its nature"* (Maturana & Varela, 1984, p. XVII). Knowledge is acquired through the learning process and learning is a very primitive biological trait.

Until recently, science has been working in mono-disciplinary fields with a reductionist approach, but trans-disciplinary and systemic approaches are becoming more popular as of late. The contribution of biology to other fields, however, has been neither clear nor well accepted; an idea that is especially evident when it comes to combining biology and social science. Preliminary efforts were made by the British natural researcher Gregory Bateson (1904 – 1980, son of the biologist William Bateson) in the middle of last century. He worked in the integration and synthesis of biological evolution and human learning. With this, he set the basis for a coherent learning theory made by closing the gap between cybernetic and information theory with Darwinism theory of evolution that existed in the 1950s and 60s. He introduced the cybernetic theory, the information and communication theory, to Darwinist evolutionary thinking and related both to the idea of learning from contexts (Niewels, 2004, pp. 141-142).

Mehler, Morton, and Jusczyk's (1984) presented a pessimistic view on the contribution of biology to cognition, which is perhaps justified by the limited methods that were available at the time. Today, however, we know that the interactions between biology and psychology can be much richer than was foreseeable just a decade ago (as cited in Dehaene, Dehaene-Lambertz, & Cohen, 2001, pp. 397 - 398).

As cognitive neuroscience research goes deeper, the relevance of biology for cognitive processes increases. In 2005, the Massachusetts Institute of Technology created the Picower Institute for Learning and Memory, which focuses the talents of a diverse array of neuroscientists on a single mission: unraveling the mechanisms that drive the human

capacity to remember and learn. In the inaugural conferences, "Vision of the Future" (Tonegawa, Kandel, Axel, & Watson, 2005), world renowned biologists awarded with Nobel Laureates were asked about the future of the brain and brain research. They agreed that a very important issue in the near future is the integration of natural science with humanities, social sciences, and engineering. In this same direction, Damasio, wrote in the preface of his book Descartes' Error: *"… at the time, writing about this idea gave me hope that a two-way bridge could be established between neurobiology and the humanities, thus providing the way for a better understanding of human conflict and for a more comprehensive account of creativity"* (Damasio, 2006, p. xx).

Therefore, the work of the emergent cognitive neurosciences seems to be an important contribution towards clarifying the role of biology in cognitive processes including learning. The following sections present two biological aspects of learning and knowledge: autopoiesis and neurobiology.

THE BIOLOGICAL THEORY OF KNOWLEDGE

Varela and Maturana proposed the **Biological Theory of Knowledge**, a theory that discusses the origins of human knowledge. They exclude the idea on transference of information as input because it is incompatible with a biological explanation of the being (see Varela & Maturana, 1980).

This theory, alternatively called the **Theory of Autopoiesis**, was proposed before the end of 1970s, and it has spread to many fields (Ruiz, 2009). For example, Mingers (1991, pp. 331 - 334), presents applications of this theory in vastly different fields: psychotherapy, computer systems design, and law. In contrast, it had a little impact on the biological sciences until 1995 when Margulis and Sagan referred to autopoiesis as follows: *"Chilean biologist Humberto Maturana and Francisco Varela see in metabolism the essence of something quite fundamental to life. They call it "autopoiesis." Coming from Greek roots meaning self (auto) and making (poiein, as in "poetry"), autopoiesis refers to life's continuous production of itself. Without autopoietic behavior, organic beings do not self-maintain – they are not alive* (Margulis & Sagan, 1995, p. 17)

The autopoiesis theory in short states that a living system … *generates and specifies continuously its own organization through its operation as a system of production of its*

own components, and does this in an endless turnover of components under conditions of continuous perturbations and compensation of perturbations … (Maturana & Varela, 1973, p. 79) and can be simplified as shown by Maturana in Figure No. 8. According to the theory, living beings are closed systems. They interact with their environment only in their niches, but they can be disturbed and will thus react to external disturbances. However, they will always keep their circularity, because a loss of it means a loss of the necessary conditions to live. Therefore, a dramatic perturbation could result in death.

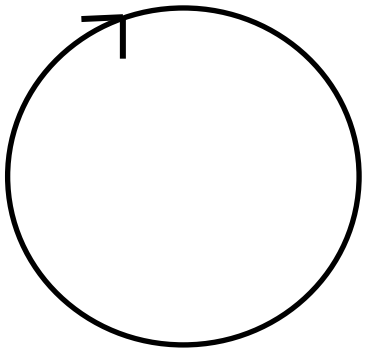


Figure No. 8 *The circularity organization of living beings.*
(Figure used by Maturana (2011) during the conference "How do we know that we know" at Tübingen University)

Maturana (1991, pp. 26-28) gives an explanation of some biological concepts related to cognition as a basis to understand autopoiesis (see Figure 8):

1. A living system, due to its circular organization, is an inductive system and functions always in a predictive manner: what happened once will occur again. Its organization is conservative and repeats only that which works.
2. Since the niches of an organism is the set of all classes of interactions into which it can enter, for an observer any one of the organism's behaviors appears as an actualization of the niche, that is, as a first order description of the environment.
3. An organism can modify the behavior of another organism in two basic ways:
    a. By interaction with it
    b. By orienting the behavior of the other organism

    In the first case it can be said that the two organisms interact; in the second case they communicate.

4. In an orienting interaction the behavior of the first organism, as a communicative description causes in the nervous system of the second one a specific state of activity that embodies the relations generated in the interaction and represents the behavior of the second organism connoted by the orienting behavior of the first one. [1]
5. If an organism can generate a communicative description and then interact with its own state of activity that represents this description, generating another such description that orients towards this representation …, the process can in principle be carried on in a potentially infinite recursive manner.
6. A nervous system capable of recursively interacting with its own states as if these were independent entities can do so regardless of how states are generated, and in principle can repeat these recursive interactions endlessly.

Varela and Maturana (1980, p. 82) claim that autopoiesis is necessary and sufficient to characterize the organization of living systems. Autopoietic systems (machines) are characterized by (*idem*, pp. 80 – 81):

1. They are autonomous; that is they subordinate all changes to the maintenance of their own organization, independently of how profoundly they may otherwise be transformed in the process.
2. They have individuality; that is, by keeping their organization as a variant through its continuous production they actively maintain an identity which is independent of their interaction with an observer.
3. They are unities because, and only because, of their specific autopoietic organization: their operations specify their own boundaries in the processes of self-production.
4. They do not have inputs or outputs. They can be perturbed by independent events and undergo internal structural changes which compensate these perturbations.

From the above, we can summarize that an autopoietic system is organized as a network of processes of production (transformation and destruction), which produces the

[1] This has been recently documented with the discovery of mirror neurons. Mirror neurons became active both when the monkey performed a given action and when it observed a similar action performed by the experimenter. Mirror neurons, in order to be visually triggered, required an interaction between the agent of the action and the object of it (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996).

components that: (i) through their interactions and transformations regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it as a concrete unit in the space in which they exist by specifying the topological domain of its realization as such a network (*idem* p. 79). All productions in the interior of a human body respond to its necessity to ensure life, and, therefore, the human brain always acts properly, as it understands the way to ensure life.

Autopoiesis has been explored in its application to the learning process and it has been the basis for the systemic pedagogy. The many implications of this are discussed later.

NEUROSCIENCES AND COGNITION

The interdisciplinary field, "neuroscience" is relatively young. It began at Massachusetts Institute of Technology (MIT) in 1962 with the founding of the Neuroscience Research Program (NRP) by Francis O. Schmidt and a group of international scientists – physical, biological, medical and behavioral – interested in understanding the brain basis of behavior and mind (Adelman, 2010, p. 15). The study of the brain, however, is as old as science itself.

Neuroscience is the study of nervous system's anatomy and physiology. Among its most contemporary relevant proponents are: Eric Kandel, Antonio Damasio, Daniel Siegel in the USA, and Manfred Spitzer, Gerard Roth and Gerald Hüther in Germany. It is concerned with both the structure of this system in humans and other animals, as well as its function. As such, neuroscience provides a body of information that serves as a foundation for understanding how cognitive operations are carried out. There has been a recent trend in neuroscience toward the integration of biology with cognition. Out of this union, a new discipline has emerged, called cognitive neuroscience or neuropsychology, whose goal is to explain the structures and physiological processes that underlie specific cognitive functions (Friedenberg & Silverman, 2006, p. 163).

Thus, neuroscience has different levels of study: **neurobiology** studies at molecular and cellular level; **neurophysiology** studies at nervous system level; and **cognitive neuroscience** studies the higher processes of mind, e.g. learning and conscious. Traditionally the first two have been object of study in biology and medicine, and the third one has been left for psychology. To use an informatics metaphor, while psychology studies the 'software', biology tries to explain how the 'hardware' allows the occurrence of mental activities. Recently more effort has been made to develop a multidisciplinary approach to understand the mental processes.

In the field of cognition, some revolutionary ideas have been developed by Francisco Varela by stating that mind is not the brain. He goes on to say that the mind is distributed in the body, and is therefore embodied (Varela, 1999). When the brain is activated through the different components of the body, the mind appears and with it the capacity to think, remember, learn and perceive. The antagonism, or the duality mind-body, is over, and is just a remnant of acquired reflex developed from a scientific, philosophic, and cultural point of view (see Varela, 2000). However, Piaget, as biologist and psychologist, made the first contributions towards overcoming the dualisms between body and mind (Kohler, 2008, p. 19). In the same direction, Damasio says in his famous book Descarte's Error *"... this is Descarte's error: the abyssal separation between body and mind, between the sizable, dimensioned, mechanically operated, infinitely divisible body stuff, on the one hand, and the unsizable, undimensioned, un-pushpullable, non-divisible mind stuff; the suggestion that reasoning, and moral judgment, and the suffering that comes from physical pain or emotional upheaval might exist separately from the body. Specifically: the separation of the most refined operations of mind from the structure and operation of a biological organism."* (Damasio, 2006, pp. 249-250).

Because learning belongs to the higher cognitive processes, it is necessary to know how the learning process takes place in order to learn how to learn. Knowledge about learning nowadays is mainly based on the observation of behavior. Renowned psychologists and educationists have developed successful theories in the field of psychology of learning. Moreover, learning theories have been based on psychological theories like behaviorism (from Pavlov), cognitivism and constructivism (from Piaget) as main learning theories. As Pätzold (2011, p. 55) refers, these approaches, in their attempt to capture a virtually invisible process, have served as a kind of paramechanical

theory of learning process itself for a long time. Although human learning can never be observed directly – we can see a change in somebody`s behavior, but we usually cannot be sure about the reason for this change – these approaches were models for describing either a 'phenomenological' (behaviorism) or the 'internal' (cognitivism, constructivism) aspects of the process.

What is known about neuroscience comes from three main categories of procedures: investigation of brain damage, recording of brain activities in healthy subjects, and direct stimulation of the brain itself (Friedenberg & Silverman, 2006, p. 164).

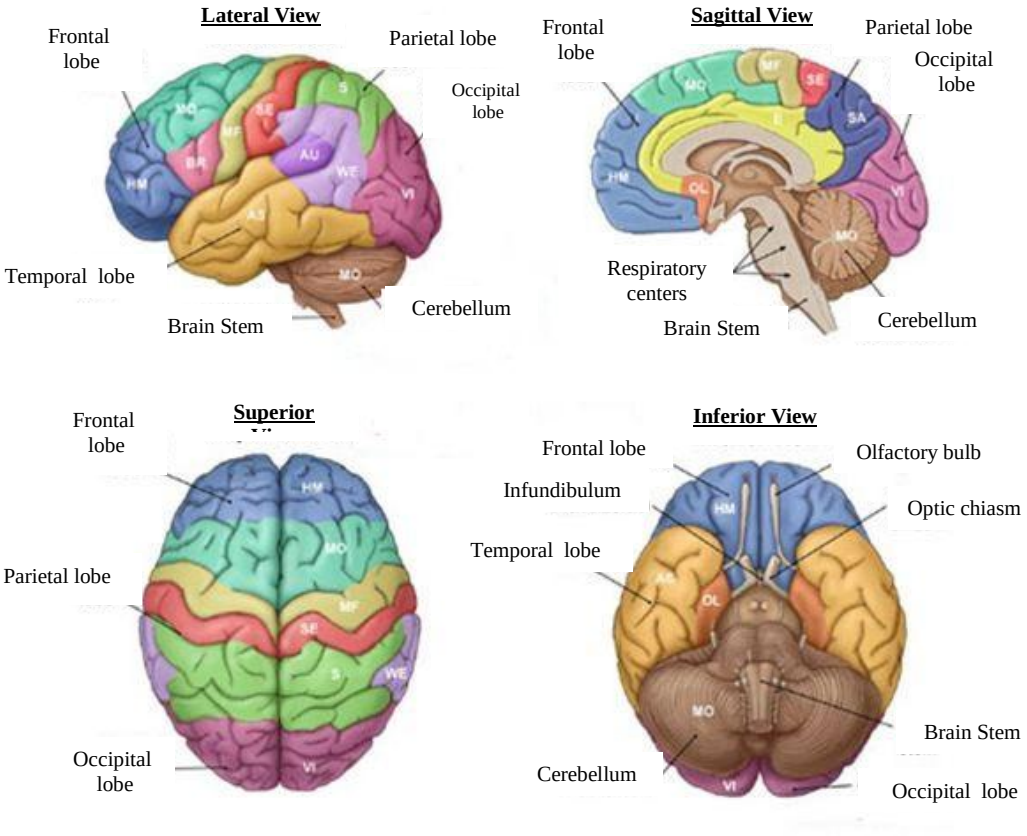
How do we learn? How do we acquire knowledge? These are ancient questions that even the Greek philosophers intended to answer. Regarding this, Friedenberg and Silverman (*idem*, pp. 45-47) present different theories to explain the knowledge acquisition, summarized as follows:

- Nativism, a significant body of knowledge is innate or "built into" an organism. Plato was the first to outline a nativist theory of knowledge. He thought learning was a matter of recollecting what is already known.
- Rationalism, must be subtly distinguished from nativism. Descartes was the progenitor of this perspective. Rationalists also believe in the existence of innate ideas. However, they additionally emphasize the existence of innate reasoning powers.
- Empiricism alternatively sees knowledge as acquired through experience. In this view, knowledge gets into the head through interaction with an environment, meaning it is learned. The senses provide the primary channels via which knowledge of the world is born. The British philosopher John Locke (1632–1704) is credited as the founder of the empiricist movement. He believed that we are born as blank slates, lacking any knowledge, and that over time experience puts writing onto the slate, filling it up.

The underlying mechanism of learning is still not clear. Kandel (2006, p. 162) recounts the very basic fact that the cellular mechanism underlying learning and memory are likely to have been conserved through evolution, and therefore should be found even in simple animals.

In any case, learning takes place through memory, perception, and the association between the two; attention also plays an important role. Learning is an embodied phenomenon. It is something in which the whole body is enrolled through the nervous system. From here, it seems important to take a look to the nervous system with respect to its anatomy as well as its physiology.

Since anatomy is not relevant for the learning process, Figure No. 9 presents an oversimplification of the brain anatomy and the function of different brain macro-structures relevant for learning (see Kandel, Schwartz, & Jessell, 1996; Bear, Connors, & Paradiso, 2009; Saladin & Porth, 1998; Tortora & Derrickson, 2006; Damasio, 2010).



Frontal lobe:
The executive functions, planning, abstract reasoning, impulse control, sustained attention and insight are all located here. It links and integrates all components of behavior at the highest level. Emotion and social adjustment and impulse control are also localized here. Awareness of abilities/limitations as well as attention/concentration and expressive language are related to this lobe.

Temporal Lobe:
The right temporal area includes musical abilities, foreign languages, visual memory, and comprehension of the environment. Left temporal area includes production of speech, naming and verbal memory. Hearing, understanding language (receptive language), and organization and sequencing skills are related to this lobe.

Parietal Lobe:
The parietal lobe is largely responsible for construction ability and language. It is related to: recall of long term memories, spatial and visual perception and academic skills (reading).

Brain Stem:
The brain stem plays a vital role in basic attention, arousal, and consciousness. All information to and from our body passes through the brain stem on the way to or from our brain.

Occipital Lobe:
This lobe is important for vision, therefore for perception and recognition of printed words (Reading).

Cerebellum:
Functions of the cerebellum are related to coordination of voluntary movement, balance and equilibrium, and some memory for reflex motor acts.

Figure No. 9 *Brain anatomy*
(An oversimplification presenting the relevant structures related to learning)
Source: (Brain Injury Alliance - UTAH; Golgeon Group Inc., 2005)

It is important to remark, that their function, as stated before, has been identified mainly through patients with brain damage. These cases allow researchers to identify specific functional areas, but it is not helpful to understand nor the connection between the parts neither their physiology.

MEMORY

Ebbinghaus pioneered in 1885 the experimental study of memory. He described the learning curve and discovered the forgetting curve and the spacing effect, using his own experiences as a source of data (Indiana University, 2012).

Since then, scientists have different ways to categorize memory. Some of them suggest that there are four types of memory: semantic (also called conceptual knowledge), episodic, procedural, and working memory (see Carter, 2010). Others like Byrne (1997) say that psychologists and neuroscientists have divided memory systems into two broad categories: declarative and non-declarative (Figure No. 10). The declarative memory system is perhaps the most familiar. It is the memory system that has a conscious component, and it includes the memories of facts and events. For example, a fact like 'Paris is the capital of France', or an event like a prior vacation to Paris. Non-declarative memory, also called implicit memory, includes the types of memory systems that do not have a conscious component, but are nevertheless extremely important. They include the memories for skills and habits (e.g., riding a bicycle, driving a car, playing golf or tennis or a piano), a phenomenon called priming, simple forms of associative learning (e.g., classical conditioning or Pavlovian conditioning), and simple forms of non-associative learning such as habituation and sensitization. Declarative memory is "knowing what" and non-declarative memory is "knowing how".

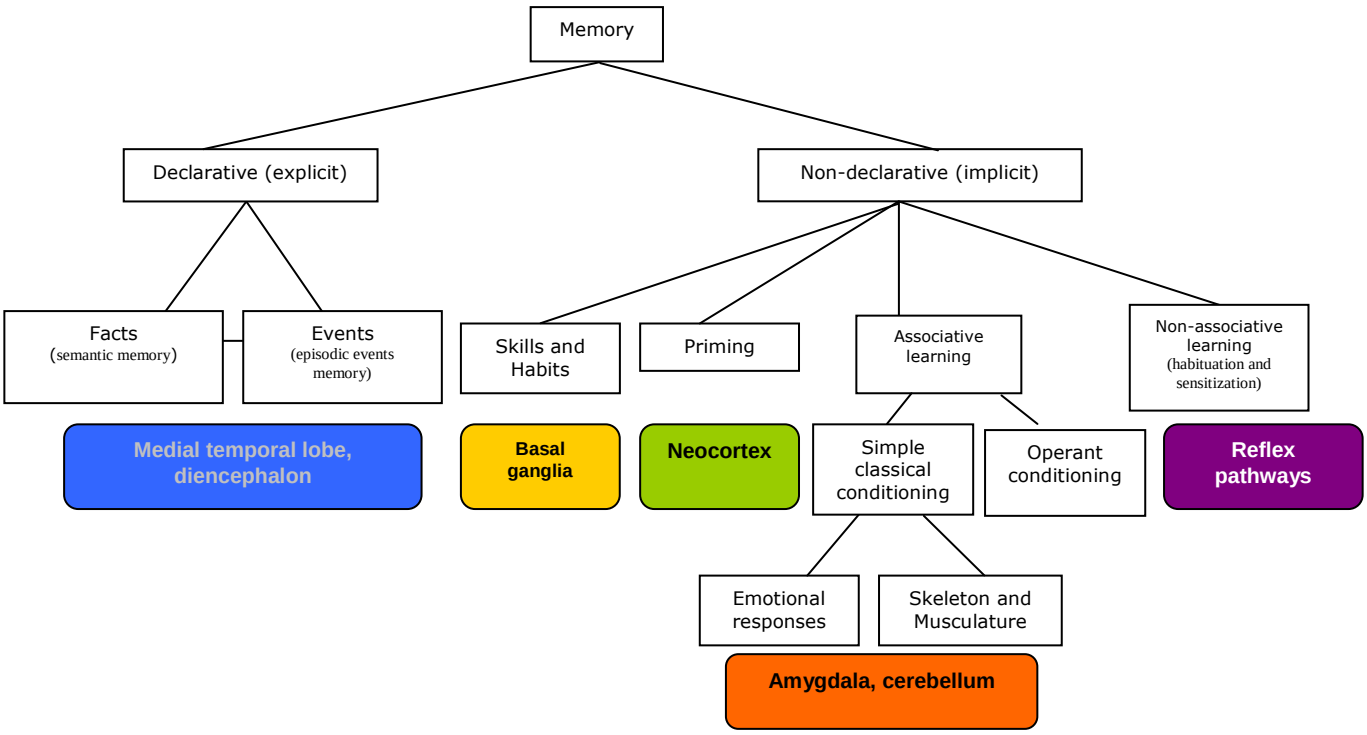


Figure No. 10 *Memory categories*
A classification of memory types and the structures involved in saving information (according to Byrne, 1997; Kandel, Schwartz, & Jessell, 1996*)*

From the learning point of view, special attention has been put on the conceptual knowledge (semantic memory, facts) related to the declarative (explicit) memory, which is shared across individuals in a given culture, although is precise scope depends on the individual's experience.

ATTENTION

The ability of the selective processing of information flowing in the same time from different sources is called attention. Imaging studies of the human brain show that brain activity during attention activities changes evidently. Attention is directed to something specific, and to one thing at a time. Studies of pathologies related to attention show that the right cingular cortex and the posterior parietal cortex are related to attention. One hypothesis suggests that the left hemisphere is important to extent attention, while the right hemisphere controls it. How is attention controlled? Is there input from higher

structures that increases activity in parietal cortex during the use of attention? Currently there is no evident answer for these questions. However some studies point out that both cortical and subcortical structures participate in the modulation of neural activity during attention. One of these is the pulvinar, the nucleus of the thalamus. And why is attention important? A possible answer is that the brain is not capable of processing the copious amounts of information coming through our senses continuously (see Bear, Connors, & Paradiso, 2009).

ASSOCIATION

Different theories have been suggested to explain the way the brain works. Some scientists assert that information inside the brain is organized according to categories. In a recent study, Patterson et al. (2007, pp. 916 - 917) state that essentially all current theoretical positions about semantic memory share the view that much of the content of our semantic memory relates to perception and action, and is represented in brain regions that overlap with, or possibly even correspond to, the regions that are responsible for perceiving and acting. However, an alternative position for which they argue is that the sensory, motor, and language specific aspects of conceptual knowledge are necessary, but not sufficient. They suggest a distributed-plus-hub view in contraposition to a distributed-only view. These seem to be the more recent approximations of the way information takes form in the human brain. The second one suggests that the widely distributed regions of the brain, along with the diverse connections between them, constitute the whole semantic network. By contrast, the distributed-plus-hub view posits that, in addition to these modality specific regions and connections, the various different representations connect to, and communicate through, a shared, modal 'hub' in the anterior temporal lobes. At the hub stage, associations between different pairs of attributes are all processed by a common set of neurons and synapses, regardless of the task.

The current information about the brain function allows us to answer the "where?" question to certain extent. However, the "how?" question remains mostly unanswered despite many attempts to solve the problem. An important contribution to the field has been made by Ramón y Cajal, who formulated the neuron doctrine that is the basis for all modern thinking about the nervous system.

The neurodoctrine is based on four principles (Kandel, 2006, pp. 65-66):

1. The neuron is the fundamental structural and functional element of the brain – that is, both the building block and the elementary signaling unit of the brain. Moreover, Cajal inferred that the axons and dendrites play quite different roles in the signaling process. A neuron uses its dendrites to receive signals from other nerve cells and its axons to send information to other cells.
2. The terminals of one neuron's axon communicate with the dendrites of another neuron only at specialized sites, the synapsis. Cajal further inferred that the synapse between two neurons is characterized by small gaps, now called the synaptic cleft, where the axon terminals of one nerve cell (the presynaptic) reach out to, but do not quiet touch, the dendrites of another nerve cell.
3. The principle of connection specificity, which holds that neurons do not form connections indiscriminately. Rather each cell forms synapses and communicates with certain nerve cells and not with others. Nerve cells are linked in specific pathways or neural circuits, signals travel along this circuit in a predictable pattern (see also Spitzer, 2007, pp. 59-77)
4. One neuron can integrate information from a number of different neurons. Typically, a single neuron makes contact through its many presynaptic terminal with the dendrites of many target cells. In this way, a single neuron can disseminate the information it receives widely to different target neurons.

What is currently known about the brain dynamic is just in their first stages and is not enough to understand the learning process *per se*. It is already known that knowledge is built through the interaction of extremely complex, dynamic neuronal networks. As a result, significant learning must be related to the creative process of living beings and their self-organization and self-production.

In order to give the neuroscience and the related sciences new and better basis to understand and explain the nervous function, a new project called the Human Connectome Project seeks to construct a map of the complete structural and functional neural connections *in vivo* within and across individuals. It aims to provide an unparalleled compilation of neural data, an interface to graphically navigate this data and the opportunity to achieve never before realized conclusions about the living human brain (UCLA, 2012).

AUTOPOIESIS, NEUROSCIENCES AND EDUCATION

Given that knowledge as a human capability is determined by learning, we will consider the main aspects of Varela & Maturana's Biology of Cognition (1980, pp. 35 - 40) regarding this:

1. Learning as a process consists in the transformation through experience of the behavior of an organism in a manner that is directly or indirectly subservient to the maintenance of its basic circularity.
2. It occurs in a manner such that, for the observer, the learned behavior of the organism appears justified from the past.
3. The learning nervous system is a deterministic system with a relativistic self-regulating organization that defines its domain of interactions in terms of the states of neuronal activity that it maintains constant.
4. Consequently what the observer calls 'recall' and 'memory' cannot be a process through which the organism confronts each new experience with a stored representation of the niche before making a decision, but the expression of a modified system capable of synthesizing a new behavior relevant to its present state of activity.
5. All changes in the nervous system during learning must occur without interference with its continued functioning as a self-regulating system.
6. Learning lies in the cognitive domain of the observer as a description of his ordered experience. Memory as a storage of representations of the environment to be used on different occasions in recall does not exist as a neurological function.
7. Learning is not a process of accumulation of representations of the environment; it is a continuous process of transformation of behavior through continuous change in the capacity of the nervous system to synthesize (Maturana, 1980, p. 45).

Some aspects of the theory of autopoiesis relevant to the educational process are:

1. Living being and autopoiesis; living beings are those who go on with preservation of their organizational identity, which is an autopoietic organization.
2. Closure and organizational determinism; that means that every change that take place in an organism, even when it is triggered by the environment, is determined

by the self-dynamic of the individual. The environment does nor determines neither conditions or defines which changes will experiment a living being, it just promotes the changes.

3. Structural coupling; the environment triggers different changes, called perturbations. A succession of perturbations that do not result directly in loss of organization, but in changes in its structural dynamic with preservation of its organization, Maturana and Varela call it structural coupling between living beings and environment.
4. Witness and observers; occidental culture, by projecting Aristotle's philosophy, points sensorial reality as something external and independent of living beings and has considered information as something transferable (Ruiz, 2009). According to the autopoiesis theory, what a human knows by sensorial reality is not something objective, defined externally and that one perceive as internal information. Therefore, changes in the structural dynamic of nervous system will produce changes in the individual reality. That means, that there is no objective reality, but so many realities as witness or observers and that in living being the process of transference of information does not exist.
5. Behavior; behavior as description is originated by the structural dynamic of the observer.

Even though the theory of autopoiesis was developed based on neurological processes, the recent advent of new neuroimaging technology used in neurosciences represents a new support for the theory. However, neurobiology is still an incipient field of research. So, how can current findings in neuroscience help educators identify particular cognitive strengths in learners? For educators, there is still an open question as how to effectively apply the research being conducted in the rapidly unfolding fields of cognitive neuroscience to educational practice (Ablin, 2008, p. 52). Critical factor mentioned in this paper are the neuroscientific community's approach to communicating results to educators and the necessity for professional development for educators in the topic.

Within neuroscience a new field is emerging, educational neuroscience, which together with a broader movement called Mind, Brain, and Education have as primary goal to join biology with cognitive science, development, and education so that education can be grounded more solidly in research on learning and teaching. Scientists and educators

need to collaborate to build a strong research foundation for analyzing the "black box" of biological and cognitive processes that underpin learning (Fischer, U.Goswani, & Geake, 2010, p. 68).

Some initial efforts are already going on. However, as Lee (2003, p. 109) says, research in neurobiology is still in its infancy, it is not surprising that some early attempts in translating research to practice involve a degree of over-generalization. At this stage, it may be more beneficial to focus on neurobiology findings that are related to educationally relevant processes. Perception, attention, association and memory are all fundamental processes related to learning with a neurobiological basis that are studied in both disciplines.

Learning, from the autopoiesis and neurobiology, is an embodied phenomenon. As such it breaks the traditions of pedagogy, where declarative knowledge has play the main role and therefore it pursuits to store as much information as possible somewhere in the brain.

One of the most relevant exponents of Maturana's and Varela's theory and its impacts for pedagogy in Germany is Rolf Arnold. In his book "*Ich lerne, also bin ich. Eine systemisch- konstruktivische Didaktik*", he uses the theory of autopoiesis plus recent results of brain research, to let clear the foundations of constructivism. He claims (Arnold, 2007, p. 56):

> *Is there any better way to justify the constructivism? Such irrefutable results describe the biology of our cognition in a hitherto unknown accuracy and right finished the basic assumption of constructivism that we see what we (can) see.*

He continues (p.59):

> *The question is therefore: which consequences result from this obligated argumentation for the Pedagogy or for the teaching or educational action? To my impression it is related and goes back in first line with the as-if-mode of thinking and acting. By this is meant that we use to act …*
>
> - *… as if our action represents a reaction to an objective reality*
> - *… as if the other causes in us this reaction, by his conduct, as such, justified and reasonable.*
> - *… as if we would know*
> - *… as if our experience makes us clever (and not blind)*
> - *… as if what we find right and certain, was right and certain*
> - *… as if the "conditions" would be guilty*
> - *… as if we can teach knowledge*
> - *… as if a lack of discipline is a fault of the parents*
> - *… as if interventions would be possible in complex systems*
> - *Etc.*

Arnold (Arnold, 2012, pp. 2-3) says that nowadays educational institutions cannot go by and continue with this and similar insights as they have been doing. They need instead to new adjust the teaching-learning ratio, they must move away from their pastoral roots. He says:

> *… in this sense Carl Rogers made a public proposal in 1969 to the "educational reform in schools and universities" under the title "Freedom to learn". He said "For me the promotion of learning is the aim (of education; R.A.), is the type and way in which we can persuade people who learn to develop themselves, how can we learn as individuals to live in continuous development. I see the promotion of learning as an activity, that perhaps holds the answers to some of the most serious problems in themselves, which today afflict humans: constructive, tentative, changing, the process entails developing answers" (Rogers 1979, p. 106).*

Actually education has taken information from psychology and translated it to the pedagogy, but results in psychology have been based on animal experiments (that is changing with the neuroimaging technology). Brembs (2009) presents an approximation of these fields in relation to their experiences until recently:

Table No. 4 *The translation from neurobiology findings in animals into learning rules (Source: Brembs, 2009, slide 39)*

Neurobiology	Learning Rules
Association is reinforced by repetition.	Repetition is the mother of wisdom
"Spaced training" favors consolidation	Not too much in once (a pause between exercises is necessary)
Avoid interference with consolidation	Calm after learning
Operant control facilitates learning	Learning-by-doing as much as possible
Context stimuli promotes recall	Text environments should be similar to learning environments
Over training lead to habits and interferes with generalization	The same topic should be worked in different ways

From this and according to Assmann (cited by (Gutiérrez, 2010, p. 223) the question would be: How to educate and how to learn? These are questions that in this society of plain knowledge, involve radically new responses because learning, from the biological point of view, is the emergent property of self-organization of life. Boff in the prologue of *Placer y ternura en la educación: Hacia una sociedad aprendiente* (Assmann, 2002, p. 11) says that learning cannot be reduced, no means, to the appropriation of knowledge accumulated neither by individuals nor by humanity. Learning occurs lifelong and through all forms of life. Therefore, the cognitive processes and life processes coincide in and with self-organization, complexity, creativity, and permanent connectivity of all with all, at all stages and moments of the evolutionary process. Learning is therefore a biological process, all living beings to exist and to live, must be flexible, adapt, restructure, interact, create and co-evolve, they must become learning beings, that means, in learning subject, otherwise they die.

Chapter IV – KNOWLEDGE MANAGEMENT: a necessary tool to better use the knowledge resource in higher education

Sharing knowledge is not about giving people something, or getting something from them. That is only valid for information sharing. Sharing knowledge occurs when people are genuinely interested in helping one another develop new capacities for action; it is about creating learning processes (Senge).

Knowledge Management (KM) is a relatively new discipline; an emerging field that can greatly contribute to many different areas. Yet, many issues remain to be solved, and much is yet to be discovered, i.e. KM has not taken its final form. Its implication for educational institutions is not yet clear, and is relatively unexplored.

KM started taking shape in the beginning of 1990s, appearing on the maps of seminars and conferences, but the debate about managing knowledge had started much earlier (Hayek, 1945; Bell, 1978 as cited by (Anand & Singh, 2011 , p. 926).

However, the 1990s are considered the point where its formal history begins. Scientists like Senge, Nonaka, and others began to propose it as a strategy to deal with information and knowledge in the organization. Since then, three generations of KM have been distinguished (Metaxiotis, Ergazakis, & Psarras, 2005, p. 7):

1. First generation (1990 – 1995): During this generation, many initiatives focused on defining knowledge management, investigating the potential benefits of KM for businesses, and designing specific KM projects. Progress on artificial intelligence influenced research on KM, mainly in the direction of knowledge representation and storing.
2. Second generation (1996 – 2002): This generation started to emerge around 1996, when many corporations started setting up new jobs for KM specialists and "chief knowledge officers". The various sources of KM were combined, and quickly absorbed by the everyday organizational discourse. During this generation, KM research touched knowledge definitional issues, business philosophies, systems, frameworks, operations and practices, and advanced technologies. On a more

practical level, the second generation emphasized that KM is about a systemic organizational change where management practices, measurement systems, tools and content management needed to be co-developed.

3. Third generation (2003 – actual): Resulting from new insights and practices, the third generation of KM is now emerging with new methods and results. According to Wiig (as cited by the same authors), "one difference from the earlier KM generations is the degree to which the third generation is integrated with the enterprise's philosophy, strategy, goals, practices, systems and procedures and how it becomes part of each employee's daily work-life and motivation….". The third generation seems to emphasize the link between knowing and action. All knowledge is inherently social and cultural, and organizational knowledge can only be realized through change in organizational activity and practice.

FROM KNOWLEDGE TO KNOWLEDGE MANAGEMENT

To understand what KM is, it is necessary to understand what knowledge is. Given that the definition of knowledge changes drastically from discipline to discipline, as we have seen in the previous section, knowledge will be understood here as a human condition. As Fahey and Prusak suggest (cited by Alavi & Leidner, 1999), knowledge does not exist independently of a knower; it is shaped by one's needs as well as one's initial stock. Knowledge is the result of cognitive processing triggered by the inflow of stimuli, and mediated by neurobiological processes. This is consistent with Churchman's conceptualization of knowledge, and his statement, *"knowledge resides in the users and not in the collection [of information]"* (*idem*). Nevertheless, the literature regarding KM can be classified into two different theoretical perspectives (Steyn, 2004, p. 168): the first includes theories that focus on the knowledge of people and knowledge construction, and the second involves theories that emphasize information and information technology.

Baskerville & Dulipovici (2006, p. 84) make a historical narrative of the field of study of knowledge and the implications for KM. They mention Zeleny in 1987 using the concept in the field of experts system; Adler in 1989 using it as an organizational resource and Myers in 1996 as an innately human quality. A more complete analysis is the one did by Chen and Chen (2006) summarized in Table No. 2.

The concept of KM is handled in different ways both in theory and in practice. Some relevant definitions are as follow:

> *Knowledge Management means dealing conscious, responsible and consistent with resource "knowledge" in order to use it in the organization (Bullinger, Wörner and Prieto, 1998 cited by* Mandl & Winkler, 2004, p. 3).
>
> *Knowledge management is the improvement of organizational capabilities through a better management of the resource "knowledge" (Probst & Rohmhardt, 1997).*

As it occurs in any other field, the necessity to delimitate the field of action of KM has led many authors to try to define it. The most frequently used definition is the one from Davenport (1998) cited by Metaxiotis, Ergazakis, & Psarras, 2005; Rowley, 2000, among others, as follows:

> *"Knowledge management is concerned with the exploitation and development of the knowledge assets of an organization with a view to furthering the organization's objectives. The knowledge to be managed includes both explicit, documented knowledge, and tacit, subjective knowledge…"*

KM is pointed as a very important tool to improve organizational performance on the corporate level, but it is scarcely found in the literature in the field of higher education institutions.

THE KNOWLEDGE MANAGEMENT PROCESS

Different authors refer to the KM process with regard to the different stages through which the knowledge passes within an organization (Chen & Chen, 2006); (Abdullah R. , Shahadubin, Alias, & Selamat, 2007); (Anand & Singh, 2011); (Ferrer & Rios, 2007). It can be summarized as follows:

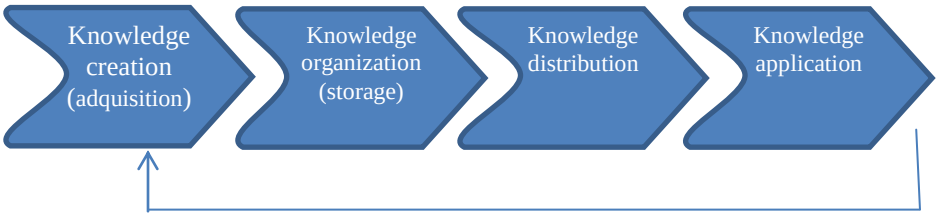


Figure No. 11 *The process of knowledge management*
Source: Alavi and Leidner (1999)

Presented here is the organizational view for the KM process following Alavi and Leidner (1999), which will be used later in the discussion for the individual level. Knowledge creation involves both adding new elements and replacing existing components within the organization's tacit and explicit knowledge. Through social and collaborative processes and individual's cognitive processes, knowledge is created, shared, amplified, enlarged, and justified in organizational settings. Knowledge storage and retrieval (knowledge organization) includes knowledge residing in various component forms, including written documentation, structured information stored in electronic databases, codified human knowledge stored in expert systems, documented organizational procedures and processes and tacit knowledge acquired by individuals and networks of individuals. Knowledge distribution refers mainly to communication processes and information flow. According to knowledge-based theories a source of competitive advantage resides in the application of knowledge rather than in the knowledge itself.

MODELS OF KNOWLEDGE MANAGEMENT

Different authors have attempted to describe the way knowledge is managed. One of the most famous model is the SECI (Socialization – Externalization – Combination and Internalization) proposed by Nonaka & Kono in 1998. It is a spiral model based on the conversion from tacit to explicit knowledge and viceversa. Another model is the Geneva Model, the model most used in organizational contexts in Germany (Schön, 2001). It is

based in six modules: knowledge identification, knowledge acquisition, knowledge development, knowledge distribution, knowledge use, and knowledge preservation.

However, as knowledge a human capability, knowledge management is not restricted to the organizational domain; it can take place at different levels, as Reinmann- Rothmeier & Mandl (2009) present in their model (Figure No. 12). According to this model, there are three main approaches to KM, individual, organization, and technique. The individual level refers to promotion and shaping of knowledge, skills, and competences in each member of an organization as carriers of knowledge and core mainsprings of a continuous learning process. The organizational level requires the appropriate structures to propitiate and facilitate the exchange of knowledge. The third element, technique, is referred to the implementation of information and communication infrastructure to make the knowledge process more efficient and usable. From this perspective, each individual occupies the central point of every KM activity (Mandl & Winkler, 2004, pp. 7-8).

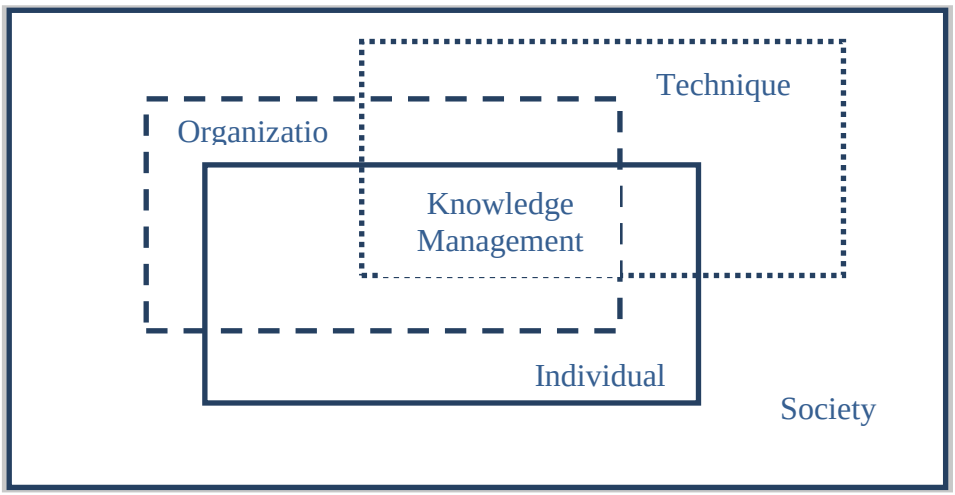


Figure No. 12 *Different levels of knowledge management*
Source: (Mandl & Winkler, 2004, pp. 7-8)

KNOWLEDGE MANAGEMENT IN THE INDIVIDUAL LEVEL

The individual level of KM gave rise to a pedagogic-psychological concept with the core idea that KM can only be successful if typical barriers between individual and collective learning are overcome. This idea emerges on the basis that individual and organizational processes and issues are tangential to each other, and, therefore, it is impossible to think of a knowledge process without psychological pre-conditions (motivation, knowledge,

skills, competences, attitudes) (Reinmann & Mandl, 2009, pp. 1055-1056). These considerations were the fundaments in developing the Münchener Model (Figure No. 13). These authors emphasize the psychological basis for KM. According to them, metacognition, learning strategies, and problem skills are requirements for an individual KM. In this sense, individual KM presents a genuine psychological topic.

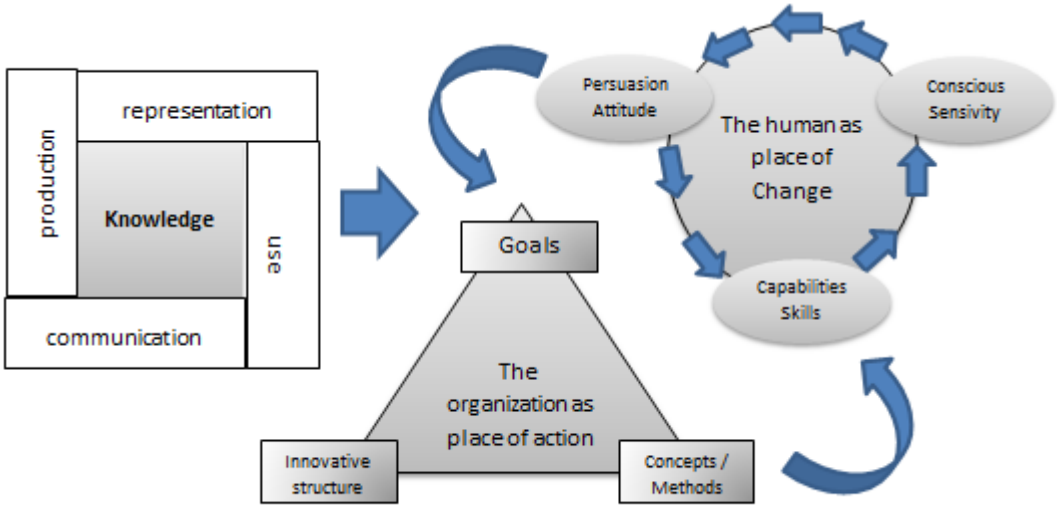


Figure No. 13 *The Münchener-Model*
Source: Reinmann & Mandl (2009, p. 1056)

KNOWLEDGE MANAGEMENT AT UNIVERSITIES

German education reformer Wilhelm von Humboldt advocated the idea of *akademische freiheit* (academic freedom) as the traditional ideal of the German university. He believed that the freedom to pursue knowledge is a fundamental principle of democracy, and defines the existence of universities. A university's pursuit of knowledge, according to Humboldt, is inexhaustible and tireless: "One unique feature of higher intellectual institutions is that they conceive science and scholarship as dealing with ultimately inexhaustible tasks: this means that they are engaged in an unceasing process of inquiry" (Humboldt c.1970:243). Similarly, in Newman's classic on the philosophy of higher education, "The Idea of a University", he argued that the pursuit of knowledge is an end in itself, and that the university is a community of scholars, lecturers, and students devoted to the pursuit of truth. The "idea" that Newman referred to in his title of 1851 was intended to be an ideal – a focal point of how universities treated knowledge as an entity pursued for its own sake, regardless of cost or consequence. This

ideal is most frequently exemplified by the university's role as 'critic and conscience of society' (Loh, Tang, Menkhoff, Chay, & Evers, 2005, p. 199).

Following Mohayidin et al., (2007, p. 302) the university is by nature an environment suitable for the application of KM principles and methods. They argue this to be true because (i) universities usually possess modern information infrastructure, (ii) knowledge sharing with others is natural for lecturers, and (iii) the desire of students is to acquire knowledge from accessible sources as fast as possible.

However, Johnson (2001, p. 143) says that there is an overlap between the functions and structures that deal with human beings, and the "vital" work that these human beings carry out in universities. This overlap is far from being an active and integrated part of a comprehensive management process – if one can speak of such a thing at universities - as ever-restrictive structures, traditional attitudes, and reactive administrative activities dominate creative and proactive crucial functions; a fact made more regrettable considering that the success of universities is especially dependent on the performance human beings bring to their work.

The dynamic of universities spins around knowledge and information. With the emergency of the knowledge society, universities have to live up to expectation of the global society. They must adopt and adapt good practices that emanate from technological advance and globalization.

Universities deal with knowledge as first resource. Malik says that they have traditionally had two main roles: creating knowledge, and disseminating knowledge (Malik, 2005, p. 120). These are done through their research and teaching activities, as well as their extension programs. The three major missions of universities are:

- Teaching – to prepare students to become successful lifelong learners
- Research – to expand the frontiers of human knowledge and to promote creativity
- Extension – to serve on communities and in leadership positions within the university and professional organizations, and to participate in outreach activities that serve the local, national, and international communities. It is shortly defined as social understanding of science through interaction with

society or the university's relationship with the non-academic outside world: industry, public authorities and society (Observatory of the European University, 2006, p. 152).

Interestingly, the three missions are related to the knowledge concept, but in different manners. While research seeks to produce knowledge, teaching intends to transfer it and extension look to apply it on the society. They are encapsulated by the administrative dimension, which tries to move the institution through the tacit and explicit knowledge of employees. To manage knowledge is a transversal activity, implicit in all dimensions of higher education institutions.

Figure No. 14 *University missions and their relation to knowledge*
(Source: self-developed)

With the rapidly changing economic environment, the role of universities and other higher education institutions as knowledge providers has been scrutinized and challenged by the various stakeholders, including the public. To answer this challenge, KM ideas and principles have been proposed to be employed by universities for the purpose of doing fundamental and applied research, teaching suitable curricular program, utilizing knowledge for management decision support to improve internal document management, and exploitation to increase the level of knowledge dissemination, and the utilization of knowledge for a qualitative change in the educational process. The introduction of KM methods and tools would enable universities to share their knowledge, to improve the level of teaching and research collaboration, as well as improving the working relationships among the staff and students and other stakeholders (Mohayidin, Azirawani, Kamaruddin, & Margono, 2007, pp. 302-303).

Rowley (2000, p. 329) suggests a list of key points that will need to be confronted by higher education institutions seeking to take a more proactive approach to an organizational KM:

- respected individuals must be involved;
- people may be reluctant to document their core knowledge;
- knowledge management practices take a while to embed;
- communities of interest are central to knowledge management;
- mechanisms for structuring and updating knowledge are necessary;
- packaging of knowledge for non-experts is important;
- progress is only achieved if specific knowledge management roles are assigned; these are likely to include roles with a focus on the validation of database content, and support and coaching staff;
- structuring and targeting knowledge helps to make staff more effective and efficient knowledge processors.

This perspective stays in the organizational approach. While the differences between higher education and business are significant, both enterprises are challenged because knowledge resides "in the heads" of individuals rather than in some more readily-accessible location. Higher education recognizes this challenge from a research perspective, and uses libraries and other KM processes (e.g., professional conferences). However, what about the knowledge related to the teaching mission of higher education? How is this knowledge managed and shared? (Wedman & Wang, 2005, p. 117)? Do higher education institutions manage knowledge?

Townley (2003 as cited in Wedman & Wang, 2005, p. 134) observed, "the academy has been slow to adopt knowledge management" (*idem*, p. 8). He identified several critical factors that prevent the adoption of knowledge management: the low priority given to knowledge management, the connection between personal and unit goals and knowledge management efforts, organizational norms related to knowledge sharing and collaboration.

Since higher education institutions are similar to any other enterprise from an organizational point of view, the possibility of using KM as an organizational tool applies to universities as well. That means that stakeholders are under the same rules and

conditions of the KM process as any other member of any other organization. The difference lies in the fact that the "products" in universities are human beings, and the goal is to develop or to propitiate knowledge creation and skills development in students.

In sum, KM at the university has two possible fields: as an organizational/administrative tool, and as a functional/operational resource (Figure No. 15). In the first case, as it has been presented here, some studies have been done, as described before, but there are still unsolved questions and it is questionable whether it is possible to apply the same strategies to manage knowledge as in any other organization. In the second case, there is no approach considering the multiple roles that knowledge, as input and as product at the same time, plays in universities, and its relevance as the reason to be of universities. Therefore, no efforts have been explicitly made to define a strategy around knowledge to achieve the best results using KM in higher education institutions.

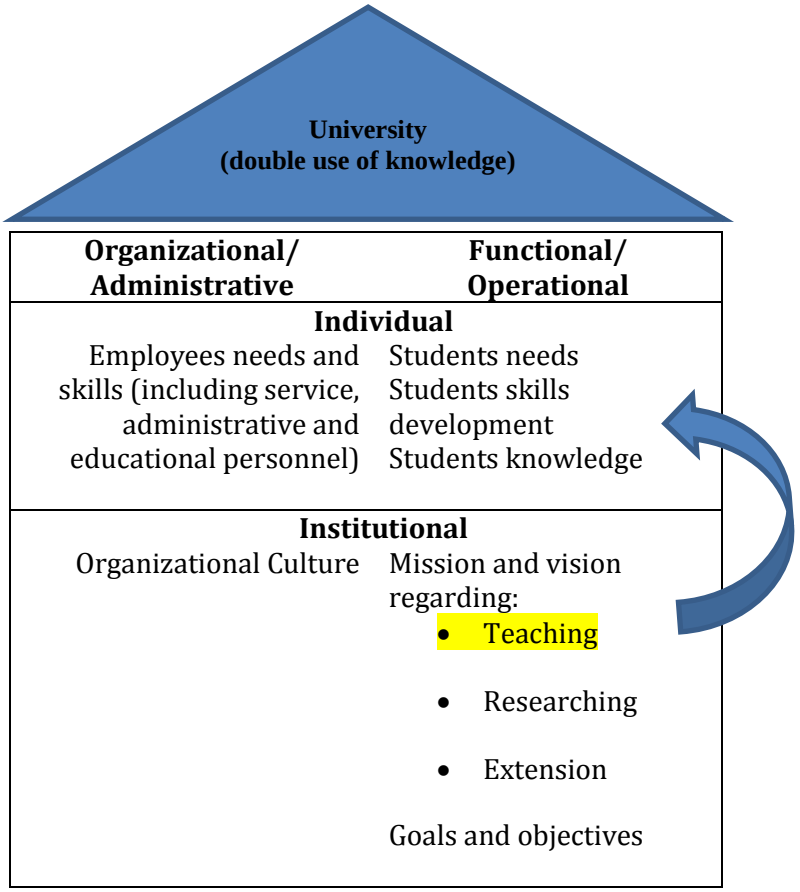


Figure No. 15 *Knowledge management at universities (Source: self-developed)*

The organizational refers to KM as it is applied in any other organization: everything related to tacit and implicit knowledge at employee level as well as at institutional level. In the functional dimension, we are referring to the gear that moves the everyday goal of an educational institution. Both of them have an individual and an institutional level.

Staying in line with a biological approach to KM, the individual functional level seems to be the more relevant for a biological model, and the institutional level acts at the individual level through the teaching mission. KM in the organizational level has been more or less developed in the context of higher education institutions, the following section will be focused on levels of the functional/operative side. Activities not related to the biological approach will only be superficially presented. The focus will be in the elements where the biological approach could be applied, which primarily means in the teaching dimension.

WHAT DOES IT MEANS TO MANAGE KNOWLEDGE ON THE TEACHING DIMENSION?

Teaching is (wrongly) referred as the transmission of knowledge; however, knowledge as a human condition is not transferable. The traditional goal of this mission is student learning, focused mainly on declarative knowledge or scientific information considered relevant to their professional life. Such transmission has been considered a responsibility of teachers and lecturers, and it is in some way. However, it does not lie in their tacit knowledge; it lies in their capabilities to allow the process of learning in the students.

The goal of a KM strategy in this sense should be to improve and develop the potential of students as much as possible by allowing them to identify their personal skills, and giving them the best opportunities possible to develop them and to achieve knowledge. To do that, many variables (also mentioned by Honduran experts during this study) play a significant role, e.g pedagogical skills of lecturers, teaching and learning environmental conditions, students' skills and interests. These variables are usually represented in the triangle of didactic as shown in Figure 16.

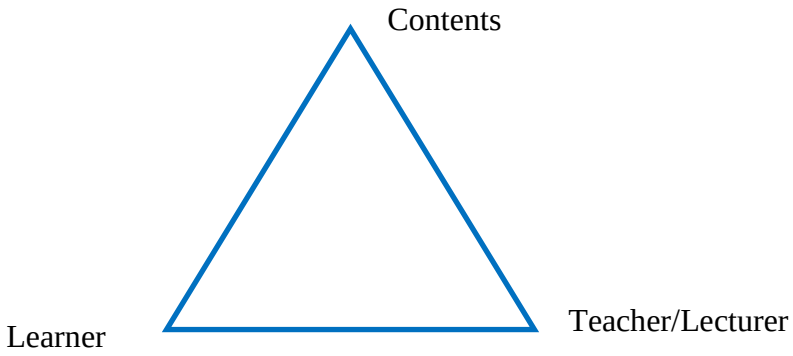


Figure No. 16 *Didactic triangle*
*(Source:*Arnold & Pätzold, 2007, p. 95)

From a KM perspective, the learning process should be learner-centered, and teaching will consider all (or the most possible) variables influencing the learning process. KM in the teaching dimension should be an integrative tool, a holistic approach.

Table No. 5 presents some benefits derived from managing knowledge in the teaching dimension, according to the theoretical frame.

Table No. 5 *Knowledge Management benefits in teaching*

Qualitative indicators	**Quantitative indicators**
Improving students skills	Increasing graduate rate
Improving teaching strategies	Increasing employability
Developing customer relationships	Decreasing costs per capita
Developing society supplier relationships	Decreasing time at the university

Knowledge is the most important resource at the university. The ability to adapt the diverse use of knowledge in a coherent and structured strategy will lead to an effective and useful knowledge management. It results clear that knowledge management in higher education will be concerned with a wide range of practices related to produce, transfer and apply knowledge.

Actually, a successful institution can be measured by its ability to manage knowledge, so that no institution, especially higher education institutions, can stay on the sidelines of the challenges of a society whose social and economic development are becoming increasingly dependent on an intangible resource: knowledge.

Chapter V – RESEARCH QUESTIONS

> *In knowledge society, contents are omnipresent and it is required from us a lifelong learning. Thus, learning centers should not guarantee the knowledge transmission, but they should prepare to the management of their increasing abundance* (*Arnold & Arnold-Haecky, 2011).*

The main goal of this research is to find a connection between biological factors and the learning process in higher education in order to use it in an optimal way to deal with knowledge management at the university. With this goal in mind, the research is comprised of specific questions in three fields:

- Higher education in Honduras (the scenario)
- Biology of Cognition (the object)
- Knowledge Management (the tool)

WHY HIGHER EDUCATION?

The scenario selected to do this research on was higher education because, as presented in Chapter II, it plays a relevant role in the development of society. Global trends are great drivers of what goes on at universities, but universities are not necessarily moving in the same direction or at the same pace as global trends.

Specifically in Honduras, the Law of Higher Education states that "*higher education aims at the scientific, humanistic and technological research, the general diffusion of culture, the study of national problems, the creation and transmission of science and strengthening of national identity Higher education should promote the transformation of Honduran society*" (Ley de Educación Superior, Artículo 3).

The mission of Higher Education will be oriented towards a comprehensive education for citizens so that they might achieve optimum academic excellence. This will be achieved by combining the many domains of knowledge with the knowledge concerning the national context, and by cultivating the purest ethical qualities and increased sense of responsibility towards its professional mission. It will enable the learner to promote

development, and strengthen the national independence in the frame of regional integration and international relations.

The responsibility of the university demands a reflection about its mission, and the way it is achieved. As time marches on, a new vision will be required; a vision of future that considers the Vision of Country 2038 on the one hand, and the global trends on the other (see Chapter II part A).

WHY BIOLOGICAL FACTORS?

In 2005, the Massachusetts Institute of Technology creates the Picower Institute for Learning and Memory, which focuses the talents of a diverse array of neuroscientists on a single mission: unraveling the mechanisms that drive the quintessentially human capacity to remember and to learn. In the inaugural conferences, "Vision of the Future", world-renowned, biologists were asked about the future of the brain and brain research. They all agreed that a very important issue for the near future is the integration of natural science with humanities, social sciences, and engineering.

Biological factors answer the "what" of the thesis at hand because several biological factors are behind the understanding of learning process. However, two of them in particular are taken into account for the purpose of this investigation: **neurobiology** and **biology of cognition** (theory of autopoiesis).

WHY KNOWLEDGE MANAGEMENT?

To answer the "how" question, knowledge management is proposed as a tool to introduce changes in the teaching dimension. However, the concept of knowledge management is handled in different ways both in theory and in practice.

In a general definition given by Bullinger, Wörner and Prieto (1998), Knowledge Management is dealing consciously, responsibly, and consistently with resource "knowledge" in order to use it in the organization. Probst & Rohmhardt (1997), define knowledge management as the improvement of organizational capabilities through a better management of the resource "knowledge" (see Chapter IV).

Each of the major missions of the university deals with knowledge as the main resource. Teaching, research, and the third mission or relation with society, make use of some kind of knowledge and aim at the transmission, production, or knowledge transfer,

respectively. In the same way, the Administrative Management should make use of elements such as experience, expertise, know-how, and institutional learning to achieve its goals.

As it is presented later, some assumptions have been made, given the complexity, the multidisciplinary and the systemic approach of this research. After each question, the document will present the scope, assumptions, and objectives, as well as a short description of the source of information, premises, and expected results.

TARGET GROUP

The empirical component of this study took place in higher education institutions located in Honduras. The information has been obtained through interviews with a heterogeneous group of experts. The participants were selected because of their experience as university managers in charge of president or vice-president at a higher education institution. They could be active managers or ex-managers in public or private universities. Current profession, age, or sex, did not play any role on the selection criteria.

RESEARCH QUESTIONS

FIRST RESEARCH QUESTION

How should higher education institutions prepare students for success in life in an ever-changing world? What should be the future of higher education?

SCOPE

Both the world of higher education and the world in which higher education plays a significant role are changing because of an assortment of environmental pressures. Key drivers include the development of advanced communication and technological services, increased international labor mobility, the focus on the knowledge society, and the growing importance of lifelong learning (Knight, 2005).

Universities are key elements in the development of a knowledge-based society. This research tries to collect the thinking of experienced Honduran academics, and to compare it with trends and actions of European universities. By analyzing futures scenarios proposed by the experts, the readiness to new approaches can be identified, ,

and, as a result, the opportunities can be found to introduce recent information of brain research and biological theory of cognition in a new learning approach with a better vision of future.

Through this research question this study seeks to understand the present, and to explore the future of higher education in Honduras through a consultation of experts. Doing this, it is possible to identify the spaces where it would be possible to introduce new approaches to the learning-teaching process that take advantages of recent brain studies, and use knowledge management as a learning tool at the individual level. This gives rise to the following research questions.

ASSUMPTIONS

Honduran universities have done well to respond to the global pressures and trends given their capabilities. However, their actions are usually conservative.

OBJECTIVES

- To rebuild the thinking of university managers about the future of higher education institutions in Honduras.
- To compare Honduran thinking with global trends based on a literature review.

SOURCE OF INFORMATION

A Delphi study provides the vision of future of higher education institutions in Honduras. The results are compared with actions and initiatives of similar institutions not only in Germany, but in the international domain. In the case of Germany, the International Centre for Higher Education Research (INCHER) in Kassel was an important source for information. This institution has a documentation centre with more than 25,000 volumes combining a broad range of themes (e.g. curricular, socialization, labour market, work issues) and disciplines in addressing the different tasks of higher education.

PREMISES

a. The vision of future is conservative.
b. Biological factors such as neurobiology and the theory of autopoiesis, remain out of consideration in the vision of the future for universities in Honduras and Germany.

EXPECTED RESULTS

The study will result in a proposal outlining the ideal actions for higher education to face future pressures and tendencies. In this ideal, knowledge management with biological considerations of learning plays an important role.

SECOND RESEARCH QUESTION

Knowledge is often said to be the main resource of universities, but what does the concept of knowledge mean? Which specific actions reflect the management of knowledge at the university? Where are the opportunities? Where are the difficulties?

SCOPE

Universities deal with information and knowledge as their main resources. However, the perception of knowledge determines the way we cope with this resource at universities (see Chen & Chen, 2006). In order to keep the scope of this project manageable, knowledge is defined as an exclusive human condition, as embodied in and used by human beings for the purpose of this investigation; it is never the same as information (as presented on Chapter 2). Among the scarce publications about knowledge management on higher education Ríos and Ferrer (2007) point out that universities should be leaders in this process. However, as Agouridas & Race (2007) say, because knowledge management is such a wide-open area of study, it is difficult to understand its implications for educational settings.

By identifying the meaning of knowledge and the relevance of knowledge management for experts, this research intends to explain how universities deal with their main resource, knowledge, through its core activities (knowledge transfer and knowledge production) during a time when information is ubiquitous, always available, and ever-expanding. This allows us to suggest new possibilities for managing knowledge in higher education institutions in a way that emphasizes the individual level of knowledge management.

ASSUMPTIONS

- Knowledge is the primary resource of higher education institutions
- The management of knowledge is an implicit activity in the university dynamic, but the intentions for knowledge management are not made explicit

OBJECTIVES

a. To identify the way Honduran universities manage knowledge
b. To find the domains where is possible to introduce the biological approach for knowledge management

SOURCE OF INFORMATION

The interview with stakeholders in Honduran universities is the main strategy to answer this research question. However, identifying the status regarding knowledge management in higher education institutions is a necessary condition to get answers.

PREMISES

a. Knowledge, as a biological capability, is determined by the way we learn, and the way we teach, but it is rarely considered in the teaching–learning process used in higher education.
b. For the purpose of knowledge management, knowledge is understood as information.
c. The perception of "knowledge" influences the kind of knowledge management implemented at universities. Also the missions of university are highly determined by this perception.

EXPECTED RESULTS

The result of this research question is the understanding of knowledge-related activities at the university achieved through identifying the meaning of knowledge for administrators on higher educations in Honduras. Also, the status of knowledge management will allow to use the spaces identified through the first research question introducing a knowledge management tool.

THIRD RESEARCH QUESTION

Which relevance do recent neurobiology findings have for learning and teaching in higher education?

SCOPE

Neurobiology, as a field of neuroscience, studies the biological basis of higher processes of mind, such as learning and conscious. For the purposes of this research, learning is understood as the process of translating information into knowledge (see Chapter 2), acquiring and using knowledge is referred as cognition (Mingers, 1991), and, as in Maturana and Varela (1979, pp. 5-7), cognition is at the same time a biological process and a function. In other words, cognition is the collection of mental processes and activities used in perceiving, remembering, thinking, and understanding, as well as the act of using these processes (Neisser, 1967) (Aschcraft, 2002).

Based on the literature, this research intends to identify if recent findings of neurobiology are able of implementation in teaching-learning processes in higher education and how.

ASSUMPTIONS

- Students go to the university with one single purpose: to learn so that they might be better equipped to face their future (professional) life in the best manner possible
- Neither the students, nor the teachers are conscious of the role that neurobiology plays on the teaching–learning process

OBJECTIVES

a. To identify how findings from neurobiology can contribute to develop a new learning-teaching approach in higher education
b. To analyze where are the possibilities in a vision of future to introduce these factors in the teaching – learning process on higher education institutions

SOURCE OF INFORMATION

At first, a literature review will provide the state of the art of the topic under investigation. The Delphi study allows us to identify the spaces in which neurobiological

information might be utilized, as well as the institutional willingness to new learning-teaching paradigms.

PREMISES

a. Biological factors do not play any intended role on the current knowledge-related tasks of universities.
b. The comprehension of biological factors underlying cognition processes and its consideration in the dynamic of teaching and learning in higher education, could contribute to improve students' performance.
c. The incorporation of a neurobiological perspective in higher education, favors an integrated bio-psychosocial understanding of the learning process.

EXPECTED RESULTS

The result will hopefully be a description of the state of the art of neurobiology and its projected future with the related implications for learning and teaching in higher education institutions.

FOURTH RESEARCH QUESTION

What relevance does autopoiesis as the biological theory of cognition have for learning and teaching in higher education?

SCOPE

An autopoietic unit is a system that is capable of self-sustaining owing to an inner network of reactions that re-generate all the system's components (see Varela, 1974; Varela, 1979; Varela, 2000; Maturana & Varela, 1979; Maturana & Varela, 1984). In other words, an autopoietic system organizes the production of its own components (Luisi, 2003). The term was suggested to understand the organization of living systems in relation to their unitary character (Maturana & Varela, 1973, p. 75) and as a necessary condition to ensure life processes.

The scope of this research question is, on the one hand, to explore the implications of this concept on the individual in relation to its willingness to learn on a theoretical basis, and on the other hand, to analyze the potentials and limitations of introducing this concept in the teaching-learning processes in higher education.

ASSUMPTIONS

- Autopoiesis as a biological process does not play any intended role in the comprehension and implementation of teaching and learning in higher education.
- There is no conscious about the self-regulation process as a biological permanent condition, which also influences the learning process.

OBJECTIVES

a. To examine the applications and limitations of the autopoiesis concept into the learning process on higher education on a theoretical basis
b. To analyze the meaning of the autopoietic approach on the dynamic of higher education institutions

SOURCE OF INFORMATION

A literature review provides the state of the art on the topic under investigation. Uses and applications of biology of cognition in higher education are identified through the consultation of experts, as are the spaces in the university where the concept might be introduced.

PREMISES

a. The autopoietic concept does not have any meaning in actual learning process in higher education.
b. A systemic approach is not the rule in the dynamic of higher education.

EXPECTED RESULTS

The study was projected to result in a list of possible applications and restrictions of the autopoiesis concept that could be meaningful to improve the teaching-learning process on higher education.

HYPOTHESES

1. The vision of future higher education in Honduras is not quite different from the model of industrial countries. It follows global trends and adopts successful models from other environments, but it is neither propositive nor innovative.
2. The potential of knowledge management as a tool has not been exploited in higher education institutions. Even though knowledge is their main resource they do not manage knowledge.
3. The neurobiological foundations of knowledge do not play any intended role in knowledge-related activities in higher education institutions in Honduras.
4. The contributions of autopoiesis to a comprehensive understanding of the learning-teaching process remain unknown and therefore underestimated.

Chapter VI – RESEARCH METHODOLOGY

> *Typically we forecast by taking one or a few innovations and fitting them in a mental image into an environment set in the familiar structure context of the past and the present. We do not visualize a future situation in its own holistic pattern. Unless the components of a system are autonomous, we should never expect to forecast the behavior of the whole by forecasting the, behavior of its parts (Linstone & Turoff, 2002).*

The University comes from an era when education represented a value in and of itself. Since the demands on gainfully employed people have changed tremendously over time, universities must find their vision for what university education should be in the present and in the future. To do this, it is necessary to conduct an analysis of their present state, which cannot consist of the invectives of politicians or the scarce financial resources (Kaschade, 2001, p. 17). In principle, a new way of thinking can be explored in any stakeholders group, administrators, teachers, researchers or students, for example. This thesis intended to make a first exploration with academicians in management positions.

The selected methodology for this research was the Delphi Consult, which was developed in the 1950s and 60s by Rand Co. as a process based on dialogue (Schulz, 2009, p. 11). Dalkey and Helmer define the Delphi Consult as a process "to obtain the most reliable consensus of opinion of a group of experts … by a series of intensive questionnaires interspersed with controlled feedback" (*idem*). It is a multi-stage process where each stage builds on the results of the previous one. A series of repeated questionnaires or rounds are used to both gather and provide information about a particular subject (Whitman 1990, McKenna 1994, both cited by Sharkey and Sharples (2001, p. 399). Its central assumption is that collective judgment and wisdom of several experts is better than the estimates and predictions of any one expert. Like other analytic techniques, it is applied mainly to make estimates or predict future human behaviors or human conditions. The Delphi Consult has been used in the fields of business, defense and education, and more recently studies using the technique within health research are increasing (Keeney, Hasson, & McKenna, 2006, p. 205).

According to Strauss & Zeigler (1975, p. 253), there are three types of Delphi Consult: Numeric, Policy, and Historic. The Numeric Delphi is used to specify a single or a minimum range of numeric estimates or forecasts on a problem. The Policy Delphi focuses on defining a range of answers or alternatives to a current or anticipated policy problem. The Historic Delphi seeks to explain the range of issues that fostered a specific decision or the identification of the range of possible alternatives that could have been posed against a certain past decision.

A Delphi Study holds the following characteristics::

1. It uses **panels of experts** for obtaining information or data. (Delphi surveys are founded on the old premise that two heads are better than one.)
2. It is conducted by **written**.
3. It systematically attempts to produce a **consensus**, as well as – and sometimes more importantly – identify opinion divergence.
4. It guarantees the **anonymity** of both the experts and identification of the expert's statements throughout the exercise.
5. It uses **iteration and controlled feedback** to converge on consensus or divergence. Participants are allowed to review and revise their statement after reading the statements of their peers, as well as evaluate all statements, reducing intentional and unintentional "noise" within the exercise, i.e., irrelevant, non-productive and potentially frustrating communication.

In the current study, a Policy Delphi has been used to achieve a common vision about the present and the future of higher education in Honduras. Key considerations for this purpose are the perception of the knowledge concept, and the perspective of using knowledge management as a tool in higher education mainly at the individual level.

PARTICIPANTS

Delphi is restricted to experts. Who is an expert? Meuser & Nagel (as cited in Dörner, 2012, p. 325), experts are persons who are responsible for the design, implementation of control of a problematic situation, or they have priviliged access to information or decision-processes. Following this, two main criteria were considered when selecting experts for this study: management experience and/or knowledge about higher education.

Every participant has held or is holding a position as president or vice president at an institution of higher education. According to Bolger & Wright (2011, p. 1510) Delphi panelists should be chosen to represent different viewpoints. In this way, the likelihood that multiple frames on a situation will be generated within individual panelists is increased. In this study, because of the trans-disciplinary nature of this research, respondents with varying professional background were desirable in order to avoid the overestimation caused when all the experts come from the same field.

Nineteen experts participated in this study, thirteen in the first round and eleven in the second round. Four participated in both rounds. All participants gave written informed consent before participating in the study.

Each expert has prior (or current) experience as manager, and, because the only way to occupy managerial positions is through academic positions, some academic background. Some of them have experiences in more than one university, private and public, and in the Education Ministry. Their professional background was highly diverse (see Table No. 6), which gave the study a representative character. They came from eight different universities, 5 private and 3 public. Gender ratio was 8 women: 11 males. Two were in an age range between 40 and 50, the rest were over 50. Seven of them hold doctoral degrees, seven hold master's degrees, and five hold bachelor's degrees.

Initially, Honduran experts were defined as target group, but in the second round regional experts were included as a second source of opinion. In this case, they were not only required to have experience in higher education, but also the knowledge about the Honduran context regarding higher education. Tests have shown that the origin of respondents has an influence in the results of Delphi (Häder, 2009, p. 94); however, in this case, given the similarities related to the situation of higher education in the Central American region no relevant differences were expected.

Table No. 6 *Professional background of participants*

• Economy (2) • Education (2) • Psychology • Mathematics • Medicine • Customs administration • Physics • Philosophy • Sociology (2) • Engineer (2) • Veterinary • Lawyer • Forestry • Chemistry

RESEARCH DESIGN

Most Delphi Consults require at least three rounds; however, five to six rounds are not uncommon (Strauss & Zeigler, 1975). The number of rounds depends on how much consensus or divergence there is in the group, and is thus unpredictable. Even when the process looks for the consensus, divergence will be registered in order to analyze it and include it in results as appropriate.

Policy Delphi produces verbal rather than numeric data. According to Turoff (2002, pp. 84-96), there are six phases that can be identified in the communication process that is taking place. These are:

1. Formulation of the issues. What is the issue that really should be under consideration? How should it be stated?
2. Exposing the options. Given the issue, what are the available options?
3. Determining initial positions on the issues. Which are the ones everyone already agrees upon and which are the unimportant ones to be discarded? Which are the ones exhibiting disagreement among the respondents?

4. Exploring and obtaining the reasons for disagreements. What underlying assumptions, views, or facts are being used by the individuals to support their respective positions?
5. Evaluating the underlying reasons. How does the group view the separate arguments used to defend various positions and how do they compare to one another on a relative basis?
6. Reevaluating the options. Reevaluation is based upon the views of the underlying "evidence" and the assessment of its relevance to each position taken.

For the purpose of this research, methodology took place in the following steps (see Figure No. 17):

1. Setting up a research team

The first recommended step is to establish a team to design every issue, and to analyze the results after each round to prepare the successive questionnaire. Working in teams assures the reliability of the method and avoids any possible bias. Due to the data being written, it is better to have the team view to prepare the questions and to analyze results in each round.

According to Turoff (Turoff, 2002, p. 88), the number of professional acting as the design-monitor team must be at least two so one can check the other. However, given that this is a doctoral research, individual work is required. To account for the discrepancy, the advisor on the project was consulted at different moments during the study to assess the reliability of data and procedures.

2. Delphi design for the first round

The first thing to do was to prepare a factual summary of background material. Statements and questions of the first round were carefully prepared avoiding compound statements to be voted upon or dual answers; giving an example of what to expect; allowing changes from suggestions; defining the criteria of analysis (importance, desirability, etc.); carefully pre formulate the obvious issues (where there could be already a consensus).

Following normal procedures for constructing survey questions, it was ensured that questions provide good operational measures of the concepts to estimate or predict.

Figure No. 17 *Flowchart of methodology for the Delphi study*
Source: self-development

3. Pre testing

For any research strategy, a pre testing with co-workers or colleagues who have not been involved in the design helps to identify weakness or confusing issues. In this study, selected professionals of the Pedagogy Faculty at University of Kaiserslautern, as well as Honduran colleagues, collaborated with this purpose. PhD level and experience in higher education were required as selection criteria for this pre-testing phase.

4. Experts selection

The optimal number of experts participating in a Delphi Consult varies according to different experience (Häder, 2009, p. 96). Regardless, a minimum number of participants should be ten. A panel of 3 would be considered too small, as larger panels reduce the possibility of mistakes. For Delbecq 30 should be the maximum, while for Brooks there should not be more than 25 (both cited by Häder, 2009). The same author cites Dalkey et al. (1969) and Becker (1974), who say that the number of participants should be no less than seven, and should have no upper bound.

An interesting experiment about the panel size for a Delphi was conducted by Duffield in 1992, who concluded *"... the same survey was conducted in two different group sizes (n1=16 and n2= 34). The results of both surveys were 92.9 similar. This shows that the reliability of Delphi does not lie in the size of the sample. Given that small panels are easier*

to organize and panel's size does not impact in results there is no reason to use large panels" (Häder, 2009, p. 96).

According to Deardorff (2006, p. 25), Delphi surveys should be developed with groups of 10 to 30 experts, sometimes more, it is congruent with the different criteria presented by Häder.

This research established a minimum of ten participants. It was decided following the literature information but also considering that:

- In small countries the number of experts is not abundant.
- Experts pools are not available and therefore the process of identifying and recruiting experts results very difficult.
- Experts are usually busy people, their low or null willingness to participate in the study could be a limitation to get a larger group.
- The context of study is limited not just by geographical reasons but also by the relatively short history of higher education in Honduras.

5. Invitation to participate

Once experts were identified, they were solicited to participate. A detailed letter of invitation was prepared in order to explain the purpose and the procedure of the study, as well as to let them know how the results will be used. Invitations were sent by e-mail, post, and fax. Given that one feature of Delphi is its anonymity, invitations were personalized so participants were not aware of the identities of other experts in the study.

The consent of experts was asked in a Letter of Consent with the following statements (see Annex No. 1 for the complete Letter):

Yes ___ *No* ___	*I authorize to publish my name in the list of consulted experts for this study.*
Yes ___ *No* ___	*I ask to keep my answers in anonymity.*
Yes ___ *No* ___	*I agree to mention my contributions in the resulting thesis and in other documents that could derive from this.*

6. The Delphi step by step

The conducted Delphi study took place in two rounds. Experts were firstly asked about their opinion on relevant topics, including the three missions of Honduran universities and the present and the future of higher education in Honduras. Secondly, experts were asked their degree of agreement and their estimation of relevance in relation to some hypothesis derived from the first round. The general procedure of the methodology is shown in Figure No. 18, followed by a detailed description of the different steps of the process.

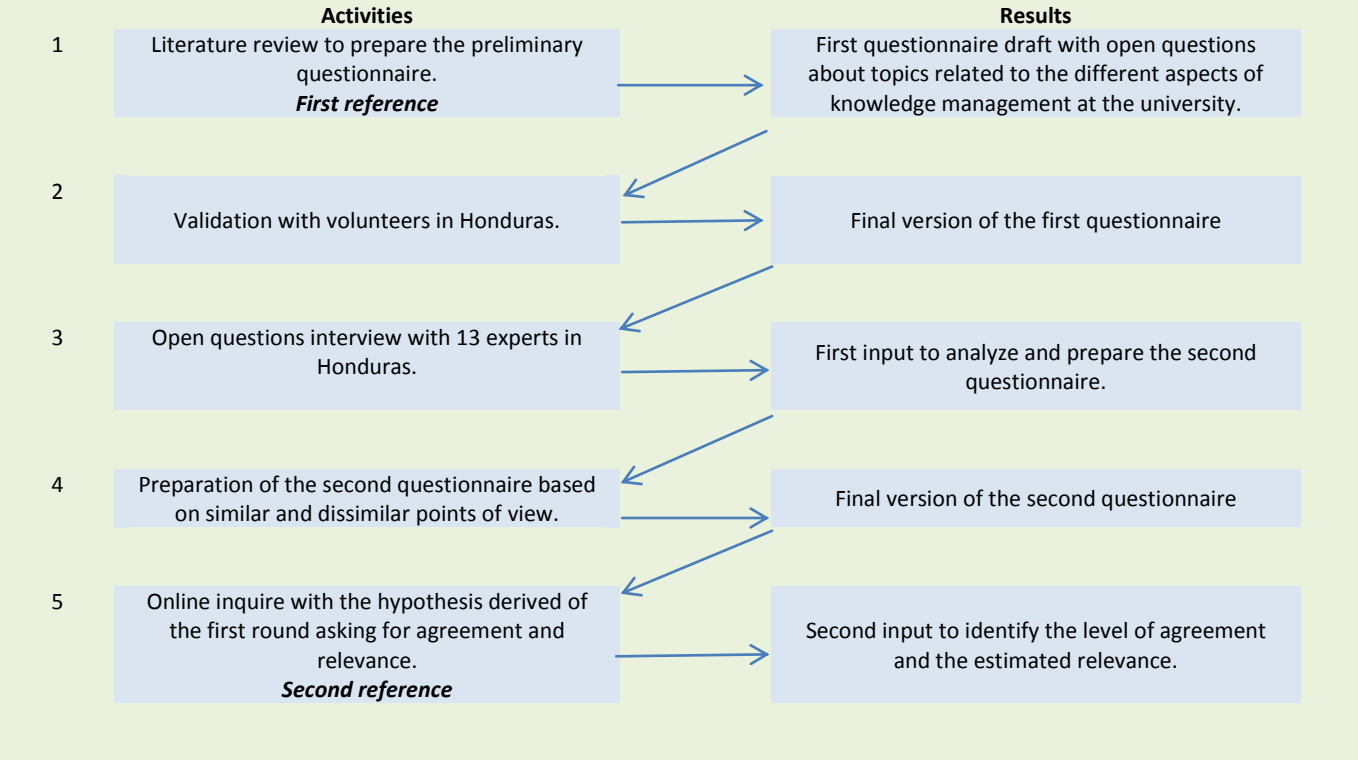


Figure No. 18 *Overview* of the phases of t*he Delphi Study conducted with Honduran experts*

Step 1 – Open-ended questionnaire: first draft

Delphi begins with an open-ended questionnaire. The questions tend to require answers that are more complex than a simple yes or no, and participants are free to respond in their own words. The questions are designed to evoke responses that are meaningful and culturally salient to the participant; unanticipated by the researcher; and rich and explanatory in nature (Mack, Woodsong, MacQueen, Guest, & Namey, 2005, p. 4). These questions are very useful in an explanatory research, and are often used to gather wide

ranging responses (Thompson, 2009, p. 420) because they seek a free response and aim to determine what is at the tip of the respondent's mind (Survey Monkey, 2008).

The first open-ended questions were carefully prepared based on literature review. Given that this kind of question deliberately seeks longer answers, the process of preparing the right questions in order to get the answer that we are looking for was really hard. The difficulty lies in the fact that once a person has an opportunity to say something, he or she has a lot to say. This effect is usually even more intense in the case of experts. However, well-placed questions steer their interest and engage them where we want them.

The first draft consisted of ten questions with the following structure (example of the first question, the complete version in Spanish is available in Annex No. 4):

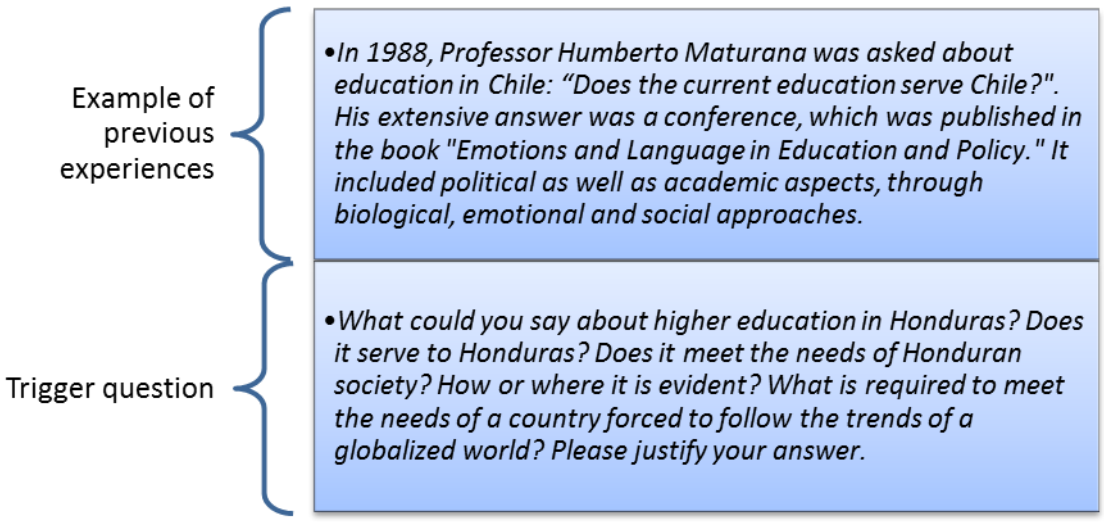


Figure No. 19 *Structure of questions of the open ended questionnaire applied in the first round of the Delphi consult.*

The questionnaire entailed the following topics:

1. Higher education in Honduras at the present time
2. Key factors for learning in higher education
3. Change and change management
4. Educational models in the present and for the future
5. The future of higher education

6. Research at higher education institutions
7. Extension at higher education institutions
8. Management and systemic approach
9. Knowledge management
10. The role of knowledge

For each question, the structure was similar to the example. Because it was important to state that somebody has already studied similar situations but in different contexts, a paragraph was presented that was based on the literature review. Information that might reveal the authors was excluded in order to avoid a bias. Each paragraph included enough information to allow a basic understanding of the issue, and to awake the opinions of the participants. Following the paragraph was a set of trigger questions that direct the sense of the interview.

Step 2 – Validation of the first draft

The first version was discussed with colleagues at the University of Kaiserslautern, and with two volunteers in Honduras before the wide distribution of the interview. During this step was also important to discuss a strategy to get useful answers. Delphi is usually conducted by written. However, for the first round, where open-ended questions could require lengthy answers, the risk of participants leaving answers blank is high with written materials. As a result, participants were consulted as to whether they would prefer a written questionnaire or a face-to-face interview. They consistently selected the face-to-face interview.

Step 3 – Interview with experts in Honduras

Experts are usually people with a full schedule. It was necessary to prepare appointments for the interview in advance, and to send them the questionnaire and instructions ahead of time to let them prepare their answers. An informed consent form was prepared and participants were asked to sign it, along with a letter of permission to use the information.

Thirty-seven invitations to participate in the first round were sent, but just twenty-nine of them reached the target destination. Thirteen accepted the invitation to participate in the first round but just twelve did it.

Interviews duration was between 60 and 125 minutes. Each one was recorded using a SONY digital recorder in MP3 format and transcribed using the f4 audio transcription program.

Step 4 – Procedure and analysis of the first round

Transcribing answers was very time consuming, as was the content analysis used as methodology to process the answers.

The content analysis is the analysis of material originated in any form of communication (Mayring, 2007, p. 11). Since definitions are mostly redundant, Mayring (*idem*, p. 12-13) developed the following list of features to describe the contents' analysis as a methodology of social sciences. He points out that these features differentiate this method from related methods. The features are:

1. The object of the contents' analysis is communication.
2. It analyses fixed communication.
3. It is a systematic process.
4. Therefore, it should be applied according to explicit rules.
5. The process is oriented by theory.
6. The goal is to draw conclusions of some specific aspects of the communication.

The steps for the content analysis in this research are summarized in Figure No. 19 (A detailed process is available in Annex No. 5). The quantitative analysis of data implies the data segmentation into singular elements. The criteria for segmentation can be quiet different; spatial, temporal, thematic, grammatical, conversational or social to name a few (Revuelta & Sánchez). For this study, the thematic approach was used as main criterion for categorization. After summarizing, debugging and paraphrasing experts' answers, a set of categories was prepared based on the similarity of opinions. This led to a new level of categories this time related to opportunities and difficulties, as well as present and future actions. Finally, these categories were grouped together according to university missions.

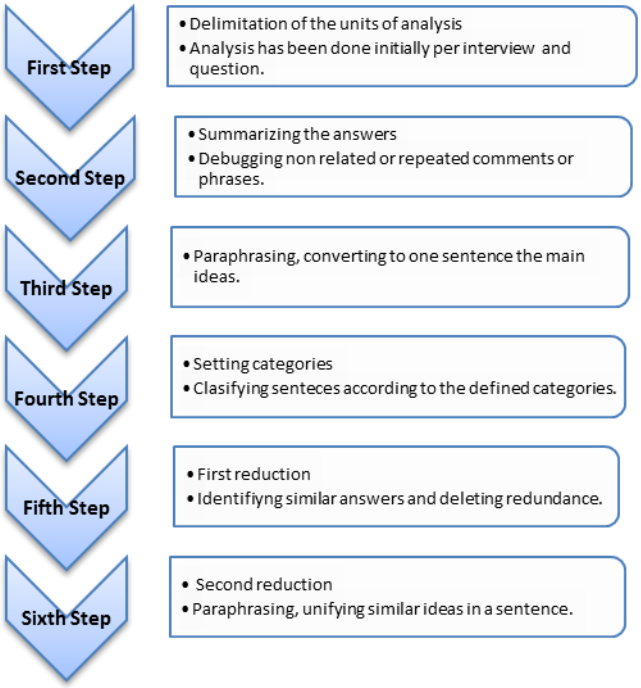


Figure No. 20 *The process of content analysis as input to prepare the second questionnaire*
Source: Self-development, following Mayring, 2007.

Analytical semantics denies the idea of a "correct" interpretation of a text. Instead, it is possible to make reasonable interpretations of a text. The level of reasonableness is dependent on certain contextual claims, which can be linguistic, logical, semantic or empirical (Lindkvist, 1981, pp. 29-30). Semantics presupposes that the language and thereby the text has an open structure, which always make it possible to create new perspectives and new precisions of the text.

Semantic rules relate concepts to words and sometimes to longer expressions. Most words can express more than one concept, and most concepts can be expressed by more than one word. The concept that is expressed by a concrete instance of a word depends on the linguistic structure of the communication; it belongs to the social context within which is published. We can say that the semantic rules define a set of possible interpretations for every sentence. Pragmatic rules are employed when choosing between possible interpretations in order to grasp at the interpretation that is the most adequate. A pragmatic rule tells us which sentences are *comme il faut* to use in a given context in order to express a certain belief or attitude. By the same token, they tell us which ways of understanding a given sentence are standard or normal in a given

audience. There is no natural language such that one interpretation of a given sentence is the true or correct (Adrén, 1981, pp. 62-63).

Hypotheses were classified in categories used for the structure of the closed questionnaire.

Step 5 – Closed questionnaire for the second round

The most difficult step of this research was to prepare the second questionnaire. The answers from the first round spanned more than two hundred pages (arial 11 and single space). The Delphi seeks to find consensus and divergence, which is pretty hard with the first round of answers given their open-ended attribute.

Using the qualitative methodology of content analysis the following moments took place:

- Preparing an abstract.
- Content analysis with semantic basis
- Defining categories which should be significant and mutually exclusive without ambiguities:
  - According to previous operationalization
  - New categories according to: presence and frequency in the answers.
- Classifying the answers within the different categories.
- Comparing the answers to the different questions on a crossed analysis.
- Debugging the categories according to their relevance to the question.

The second questionnaire was designed on the basis of the results of the first analysis, but with closed questions. It had the following structure (the number in parenthesis indicates how many questions/hypothesis were included in each section):

I. General Information about the Participant (optional)

II. The internal dimension of university

PART A: General Hypothesis (3)

PART B: Teaching dimension

TOPIC B.1 Related to the student (9)

TOPIC B.2 Related to teaching (8)

TOPIC B.3 Related to curriculum (18)

PART C: Research dimension (10)

PART D: Outreach dimension (4)

PART E: Management (19)

III. The external dimension (16)

The hypotheses were structured and experts were asked about two things:

a. **Degree of agreement**: To get their degree of agreement a Licker scale with five levels was used as follows:

No Agreement	1
Partially in agreement	2
In Agreement	3
Strongly agree	4
Absolutly agree	5

b. **Relevance**: For some hypothesis was asked the relevance of the topic for higher education, with a YES/NO question.

In both cases was given the opportunity to make additional comments or to justify their answers (see Figure No. 20).

In the second round of the survey, the experts are normally given only the measures of central tendency for the answers to the questions in the first round, and asked to explain in detail if and when their second round answers differ substantially from the first round's measures of central tendency (see Strauss & Zeigler, 1975). In this study, no information was given about the central tendency. Instead, question were prepared on the basis of consensus or disagreement, but no information was given about which question had one or other condition.

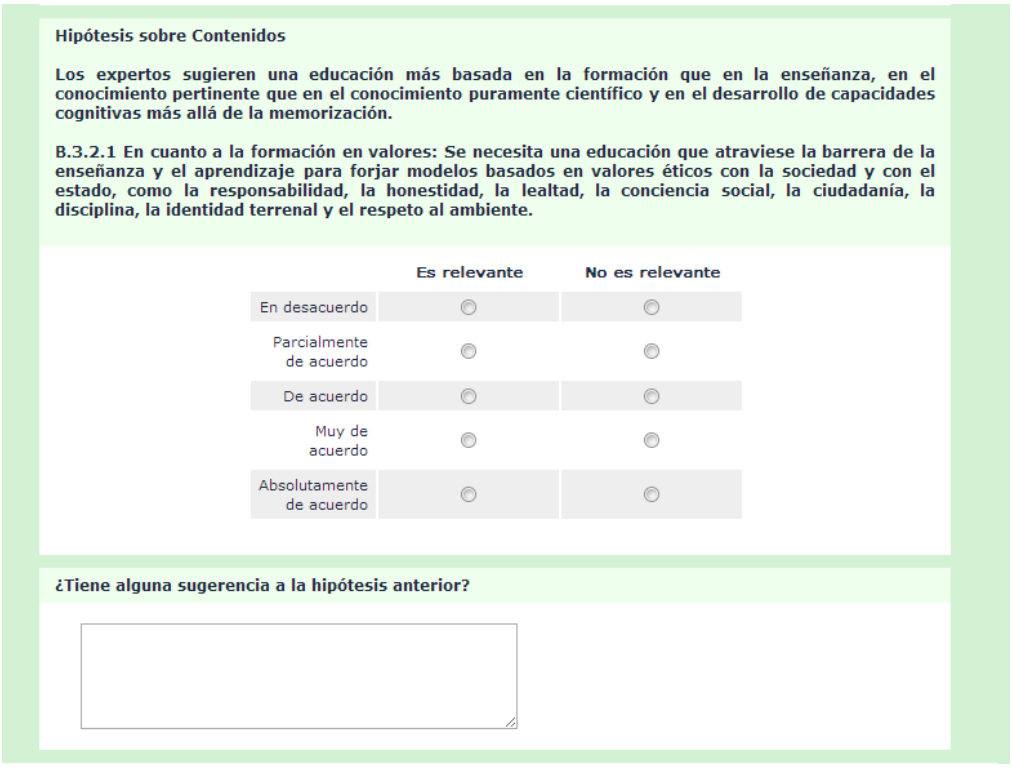


Figure No. 21 *Example of how the questions look like in the Lime Survey online platform*

Step 6 – Online inquiry – national experts

The same twenty-nine national experts were invited to participate in the second round. It was conducted online using the program LimeSurvey version 1.92. LimeSurvey is a leading Open Source Online Survey Tool written in PHP. It allows researchers to develop, publish and collect responses to surveys. Surveys can include branching, use templates for layout and design, and can provide basic statistical analysis of survey results. Surveys can be public, or can be strictly controlled through the use of "once-only" tokens for each survey participant.

However, knowing that technology could be sometimes a barrier to this kind of research, the questionnaire was also sent in Word version via e-mail. The opportunity to answer the questionnaire was as diverse as possible; it could be via e-mail, fax, post, or even in a print version that would be pick up in Honduras.

The wide range of possibilities did not improve the participation. Ten experts completed the second round and just one of them uses the word version via e-mail. One expert did

not complete the second round, but his/her answers were introduced in the results. Four of them also participated in the first round.

Step 7 – Online inquiry – regional experts

Given the low participation of national experts, three regional experts in higher education with knowledge and experience of the topic in Honduras were invited to participate in the second round. Two of them participated. Their participation enriched the results of this research.

Step 8 – Analysis of the second round

The second and successive rounds often produce "a narrowing of the initial spread of opinions and shifting of the median .... If no consensus emerges, at least a crystallizing of the disparate positions usually becomes apparent" (Gordon T. , 1971). Given the small number of participants, analysis of results from the second round was extremely easy, no especial tool was necessary to perform the analysis of frequencies. This survey showed consensus in the second round.

Because the number of respondents is usually small, Delphi studies do not – and are not intended to – produce statistically significant results; in other words, the results provided by any panel, do not predict the response of a larger population or even a different Delphi panel. The value of a Delphi study rests in the ideas it generates, both those that evoke consensus and those that do not (Gordon T. , 2002, p. 28).

An analysis of frequencies allows the results of the second round.

QUANTITATIVE versus QUALITATIVE

This research follows a QUAL – QUAN Model, a type of mixed-method model that integrates simultaneous qualitative and quantitative methods. From a quantitative point of view, this method has the following characteristics (see Gay & Airasian, 2000):

1. The identification of the problem of interest is description and explanation oriented.
2. The literature review plays a major role on the justification of the research problem and the specifications for the need for the study.
3. It uses statistical analysis and description of trends to the data interpretation.

Following the same authors, we can mention the following as characteristic of a qualitative research which are related to Delphi:

1. The selection of participants (sample) is based on participants' experience.
2. The collection of data is mainly by emerging protocols and with a relatively small number of individuals.
3. The reporting and evaluating research is flexible and reflexive.

The methodology was carefully conducted in order to ensure the trustworthiness of the qualitative data. Qualitative research, to a much greater extent than quantitative research, is a "do-it-yourself" rather than an "off-the-self" process, one that involves "taking" back and forth between the different components of the design, assessing their implication for one another. It does not begin from a determined starting point or proceeds through a fixed sequence of steps, but pre-involves interconnections and interactions among the different design components (Maxwell, 2012, p. 3).

In this research, the content analysis methodology was relevant from a qualitative point of view and the analysis of frequencies from a quantitative one.

DATA COLLECTION and DATA ANALYSIS

Delphi is a multi-stage research process. As such it involves multiple methods not only to collect data, but to analyze them as well. Table No. 7 summarizes the different methods used in both cases.

Table No. 7 *Data Collection and Data Analysis for each round*

	Delphi Study		**Concepts Perception**
	First Round	Second Round	
Data Collection	**Interview** Open ended questions	**Questionnaire** Closed questions	**Result of interviews**
Data Analysis	**Content Analysis**	**Analysis of frequencies**	**Content Analysis**

During this research the data collection were carefully designed in order to optimize and ensure quality during the whole research process. The following criteria were especially considered:

1. **Time**, respondents are in Central America, while the research is conducted in Germany. Given that this study is the basis for doctoral studies, the Delphi

should be conducted in a limited period of time. To better use this resource, the first round was conducted face-to-face, in Honduras, recording interviews.

2. **Anonymity**, a great part of reliability lies in anonymity. Participants do not have the opportunity to influence or be influenced by others. However, given the iterative process inherent to the process, answers are not anonymous to the researcher. Some authors label this as quasi-anonymity (Keeney, Hasson, & McKenna, 2006, p. 209).
3. **Reliability**, questionnaire cannot be answered two times by the same person. Also all the interviews have been recorded, and the questionnaires were saved on a local drive, reducing the possibility of data manipulation and allowing the verification by others, if necessary.
4. **Validity**, the study follows the well-known rules of content analysis. Original interviews were recorded and transcribed, so the validity is easy to be proved.

A number of authors claim that the Delphi approach enhances reliability. This belief is based on two principles. Firstly, the claim that the interactive nature of the approach combined with the avoidance of group bias and the occurrence of group think scenarios, enhance the reliability of the results. Secondly, as the panel size increases, the reliability of the respondent group also grows, based on the belief that a larger group will reflect the opinion of the population, providing a smaller confidence interval. Such claims have been widely questioned as the larger the sample the more variation can occurs, diminishing the degree of accuracy and level of generalizability. Such scenarios can lead to a false consensus being obtained, as it forces participants to reach a consensus without any opportunity to debate the issues (Hasson & Keeney, 2011, p. 1698).

Regarding validity, many authors claim that Delphi is a valid procedure. However, this can at times be a sweeping statement, with little detail provided in the types of validity attained. Validity should refers to content, as well as to the construct and criterion-related (*idem* p. 1700). However, a number of authors believe the term trustworthiness is more appropriate than reliability and validity to gauge the effectiveness and appropriateness of a Delphi study. To establish trustworthiness there are four main strategies: credibility, dependability, confirmability and transferability, all of them are implicit in the Delphi study (*ibidem*).

Chapter VII – RESEARCH FINDINGS

I never teach my pupils; I only provide the conditions in which they can learn. (Albert Einstein)

As mention in the methodology section, the empirical component of this thesis comes from a Delphi Study. The general objective of the Delphi was to identify the thinking of experts about the current situation of higher education in Honduras, and about their perspective of future. Specific objective of this research was to explore opportunities to introduce a new learning approach with elements coming from neurobiology and theory of cognition.

The methodology seeks to reach consensus or majority of opinion, through iterative consultation. This Delphi was conducted over two rounds the first of which was conducted in August 2011. It took place in Honduras in the form of face-to-face interviews.

As it was described previously, responses to the open-ended questions that were obtained during the interviews were analyzed using the Content Analysis method. This exercise led to a list of hypotheses that were consulted when searching for consensus in the second round. The hypotheses were structured into a second consult, this time in the form of an online questionnaire. The results of the first round were also used for a supplementary analysis carried out to find the understanding of knowledge in higher education institutions, and to identify the use of knowledge management as a tool to improve the performance of universities.

By identifying the comprehension of knowledge and KM, it was also possible to understand the management of knowledge-related activities at higher education institutions in Honduras. Moreover, the study sought to discover if the biological approach to knowledge and the individual level of KM play any role in the definition of tasks, objectives, goals, and general plans at the same institutions.

DELPHI FIRST ROUND

As mention before, the content analysis showed that problems at the university can be disaggregated into two main groups related to the context: the internal dimension, and the external dimension. The internal dimension was in turn divided into different categories the classic task division at Latin American university. The results for both dimensions are presented in the following sections (a general overview of categories for the first round is presented in Table No. 8).

INTERNAL DIMENSION

The internal dimension refers to every aspect of activities taking place at the university as a part of its routine, or of its reason to be. It has, in turn, a set of components: teaching, research, extension, and management (see Figure No. 22).

Therefore, experts' opinion about the internal dimension was classified into five sections. Each section includes the hypotheses that were presented to experts during the second round. Sections were as follows:

1. General hypothesis
2. Teaching dimension
3. Research dimension
4. Extension dimension
5. Management dimension

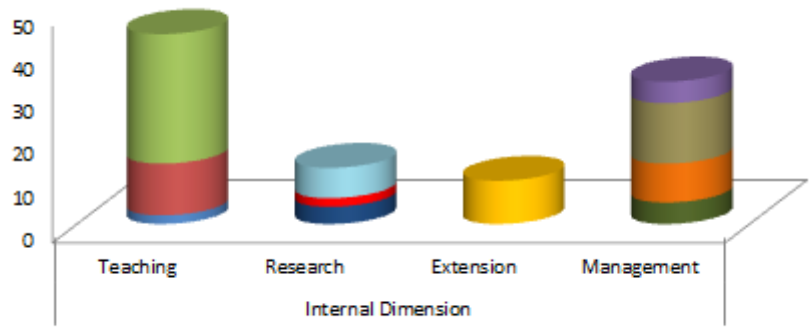


Figure No. 22 *Categories of the hypotheses related to the internal dimension. Source: Results of the Delphi Study – first round*

EXTERNAL DIMENSION

The external dimension is related to those aspects where university interacts and depends on different and diverse factors in the outside world. Universities are immersed in society, and have a great responsibility within it to play a major role in the sustainable development of the country. That means that university is not an isolated place and its impact should go beyond borders.

DELPHI SECOND ROUND

The following pages present the results of the second round, and show that it was sufficient to identify agreement among experts. The order of presentation follows the structure of the questionnaire of the second round. A Licker scale was used to identify the degree of agreement; its visualization in the graphic is facilitated by the use of a scale of colors from dark green to red (absolutely agreement to disagreement) with yellow in the intermediate position (just agreement) as showed below:

Absolutely agree	Strongly agree	Agree	Partially agree	Disagree

GENERAL HYPOTHESIS

In general hypotheses, three issues were identified. Each one conform a hypothesis used in the second round questionnaire. Results are presented in Figure No. 24.

> *A1. Higher education comprises a very complex system with a vast assortment of internal elements. However, it is simultaneously a subsystem of a larger system where government, society, enterprise, and environment play a major role. A satisfactory university in Honduras should be related with all these elements.*

Experts agree with this statement. Additionally, they insist that changes should begin in the internal dimension.

> *A2. Changes in the internal dimension means change in the major missions of university plus its management. Some missions urge changes more than others, as shown in Figure No. 22. This figure shows that changes should primarily take place in the teaching dimension, followed by the management, research, and extension dimensions respectively.*

This is one of the eight hypotheses where consensus is not clear. While six experts were on the opinion of agreement, five were on the side of disagreement. After analyzing their reasons for disagreement, it is possible to point out that disagreement lies in how each individual perceives university and its missions. Some see missions as independent units, while others see the university as a whole and therefore missions are interrelated. Regardless, experts suggest that changes should not only occur in the internal dimension, but also in its relation to the external dimension. Moreover, they strongly suggest that changes in one dimension will not have success unless university administration is highly committed to the other dimensions.

A3. Areas that must change to have a satisfactory university were pointed out by experts, and categorized as shown in Figure below. If you do not agree, add any necessary text, and explain your decision.

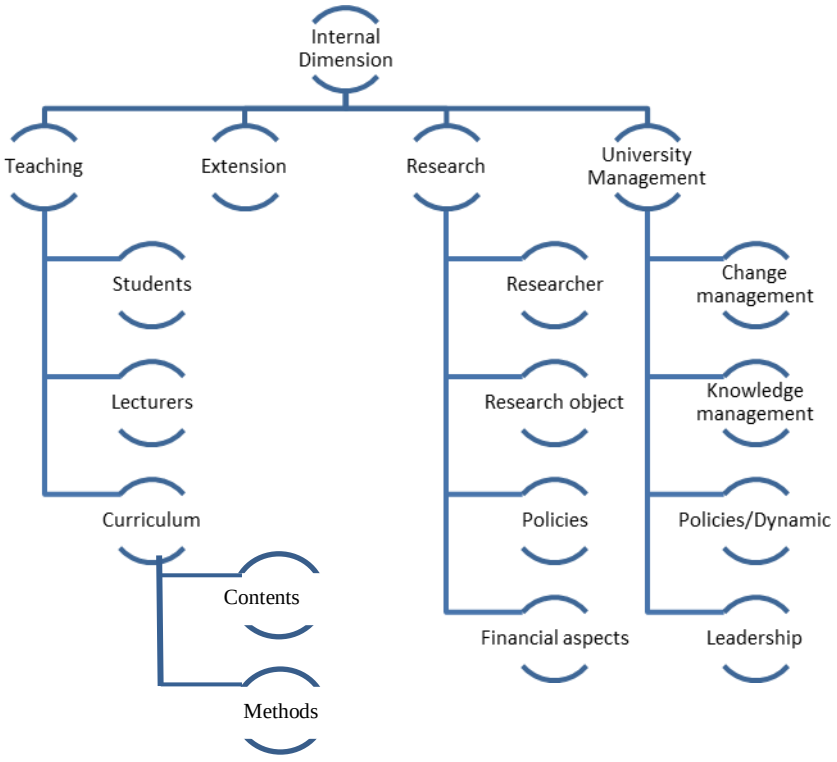


Figure No. 23 *Categorization of the opinion of experts in which changes should take place in order to have a better university in the future. (Source: Results of the Delphi – first round)*

Agreement with this classification goes from absolutely agree to agree; only two experts were doubtful about it. Their doubts lie in the fact that changes require financial support. They therefore feel the available budget should be the primary concern in any action. Ultimately, financial aspects are the pragmatic basis of any intended intervention, and it should be considered a cross-organizational factor located in the management dimension. In addition, all activities together should be considered as a single institutional mission instead considering teaching, research, and beyond as separate dimensions of university action; they are, in reality, interrelated, and interdependent of each other.

The standard for a good future university profile is usually the profile of universities in industrial countries. When comparing the profiles Honduran universities with the standard, some experts have suggested that the emphasis on research is the main difference. While universities in developed countries have the capital to invest in research, financial resources are scarce in universities of less developed countries; as a result, attention, priorities, and resources are placed on teaching.

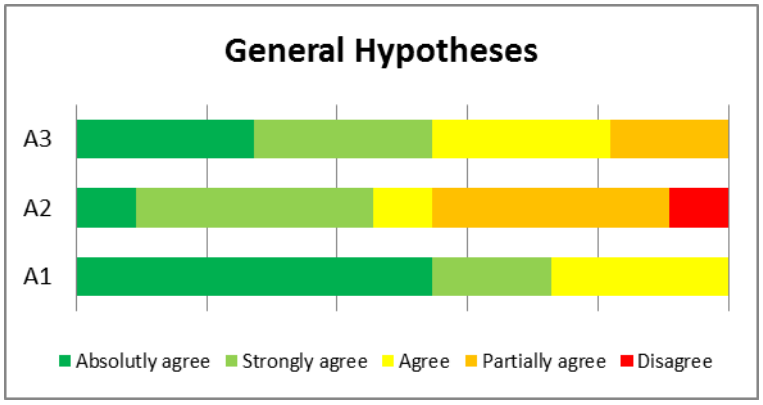


Figure No. 24 *Degree of agreement for the hypotheses A1 to A3 (General Hypothesis)*

TEACHING DIMENSION

Experts understand teaching in its most traditional way. In other words, their conceptualization mirrors the definition used by Arnold and Feder (2006, p. 23): *" ... teaching (docencia) is perceived as the activity conducted by lecturers in order to teach, inform and/or instruct students".* However, they agree that teaching should move from a teacher-centered activity to a learner-centered process.

Three elements are mentioned in this dimension: students, lecturers, and curriculum. Each element corresponds with an element of the didactic triangle presented in Figure No. 16. We can then adapt the triangle according to the findings as shown in Figure No. 45. Changes for the future of higher education are mainly suggested in the second element: lecturers.

STUDENTS

The hypotheses regarding students are not directly related to the students themselves, but to the educational system prior to tertiary education. Another factor that directly affects students is the paucity of measures adopted by the university aimed at helping students acquire capabilities, skills, and knowledge that would prepare them to successfully achieve their degree. Summarizing, problems related to students are:

1. Low academic ability at the beginning of university, mainly in Mathematics and Spanish (reading and writing).
2. The lack of remedial measures in the higher education system.

The low academic ability of incoming students is the largest problem that universities have to face related to students. Even though it affects the academic profile of the university, universities currently do not work towards a solution. Therefore, experts propose two measures as possible solutions to make up the gap between secondary and tertiary education. The first looks to improve the level of incoming students through remedial courses. The second aims to create more opportunities to access postsecondary education by reconsidering factors like the admission test, alternative offers, and better coverage.

Hypotheses under these considerations were as follow:

> *B.1.1 Universities must provide remedial courses mainly in the area of Spanish and Mathematics because studies have shown severe deficiencies in those disciplines.*
>
> *B.1.2 An equivalent to preparatory schools should be organized; some kind of postsecondary/pre-university institution to prepare students for a successful college career according to their interest.*
>
> *B.1.3 Admission testing should take into account the following:*

B.1.3.a. The admission test must be unified for all universities. The current situation shows that, while a student gets poor results in the admission test of one university, he or she could get good results in the admission test at another university.

B.1.3.b. The admission test must be validated. Currently, there are no studies that determine if students who fail to enter university are not really fit, or do not have the skills required for college. Hence it is suggested that some research to validate the effectiveness of admissions tests should be done.

B.1.3.c. Admission tests are exclusive; they favor those who have had a better chance at education, which are generally those who have attended private schools. This jeopardizes the right to education, and becomes another obstacle for those that do not have access to private schools. Therefore, admission tests become something serious in a society where there are already many impediments to entry to higher education, including factors like the economic and geographical factors inherent to the students, or the low coverage of university.

B.1.3.d. Having said this, the following becomes imperative to improve access to higher education:

> *B.1.3.d.i. Improving the level of secondary education mainly in the public system.*
>
> *B.1.3.d.ii. Having options for postsecondary that are alternative to college (training institutes, professionalizing schools, technical training, etc.).*
>
> *B.1.3.d.iii. Improving coverage through new forms of access (regional centers, distance learning, virtual education, mobile education, etc.)*

B.1.3.e. Admission tests are necessary to ensure the quality of university education.

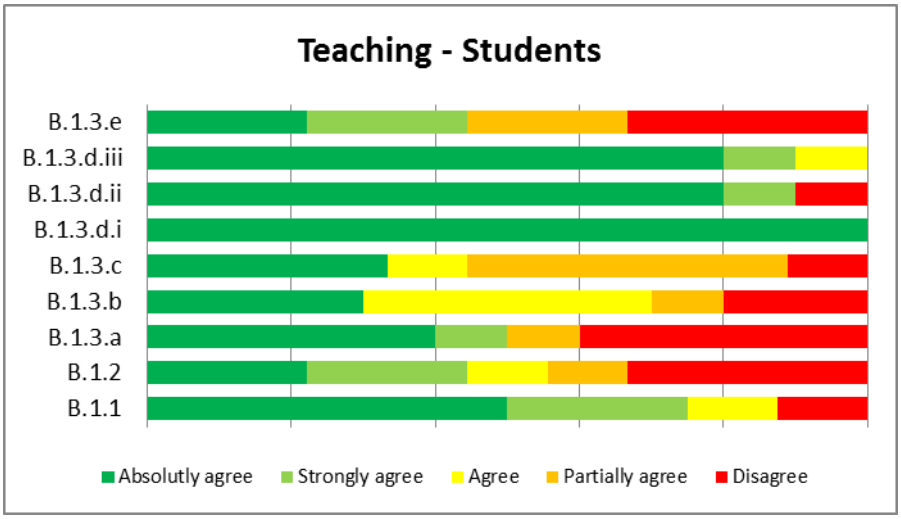


Figure No. 25 *Degree of agreement for the hypotheses B1 Teaching dimension (Students)*

At the present time, the academic performance of students in universities is strongly influenced by the quality of their secondary school education. Efforts to standardize the quality of secondary education have been made neither by the educational system, nor by the university. Consequently, repeating a class/lecture because of an insufficient grade is part of the routine for students in their academic life. The significant impact of class repetition can be observed in two major phenomena. For the student, repeating a class means more time before getting a degree. Lengthening a student's might lead them to drop out because of demotivation, economic reasons, or personal commitments like a job or a family. For public universities (and therefore for the state), it is economically unsustainable to keep students for 10 years, occupying the place that other students need. Levels of terminal efficiency are seriously affected by this situation.

Experts also mention that the most effective way for tertiary education to influence the educational system and to improve the quality in the secondary level would be to support teachers, and improve their skills and capabilities.

The admission test in Honduran universities is only an academic attitudinal test, and it is not considered a factor that influences the quality of higher education.

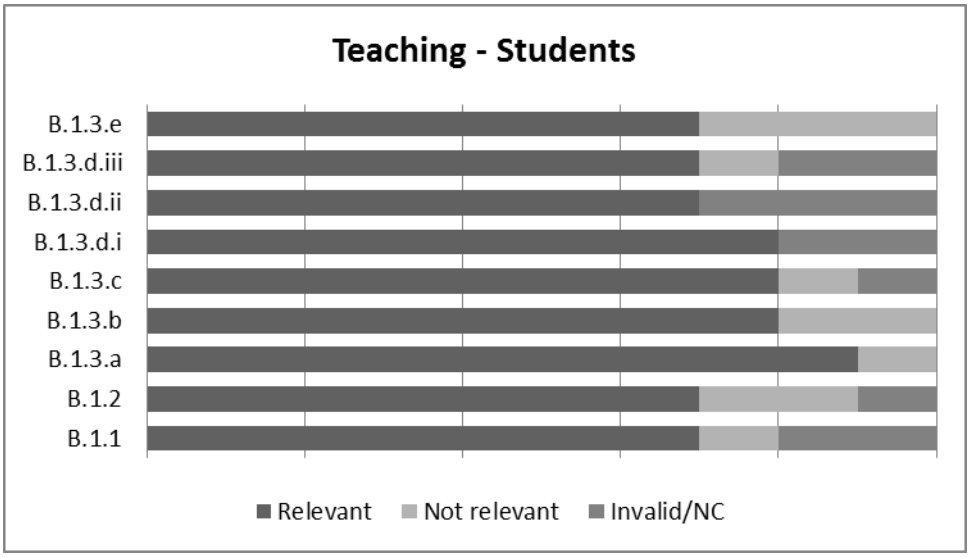


Figure No. 26 *Relevance for the hypotheses B1 Teaching dimension (Students)*

Concerning hypothesis B1, it is possible to conclude that for experts, the topic is relevant. The isolated cases of disagreement are mainly justified by the lack of research on the topic. Opinions, and therefore the suggested hypotheses, are based on the experience of university managers, who are also academics, but without data to confirm the experience. Arguments in this sense are related to who should be responsible for the deficiency: the higher education system, the secondary level, or the student itself. In any case, it is clear that economical limitations are a major restriction on projects to repair the deficiencies. No less important is the fact that universities are not offering new majors, and therefore the motivation and interest of students is weak considering that they already have access to the state of the art in all disciplines.

Finally, some remarkable comments of experts regarding students are as follows:

> *"Learners come to universities with great disadvantages because of the bridgeless gap between secondary and tertiary education".*
>
> *"Every student has potential, but they need to feel confident and trust their lecturer. Here emotions and affections play a significant role".*
>
> *"Learning is a multidimensional process. Psycho-pedagogical factors are important, but there are other considerations, i.e. the social valorization of each student. This in turn, is related to the social capital, solidarity, social cohesion among others. In*

addition, students in healthy environments (those who propitiate positive factors for life, according to the World Health Organization) are more able to learn".

"Students need to be motivated and trustful in what they are learning. Minimal conditions should be assured. Learning is hard if you are hungry because of poverty or tired because of working to support your family".

INSTRUCTORS/LECTURERS/TEACHERS

As stated before, a strong emphasis was put on the instructors (lecturers/teachers) in the teaching dimension. Experts mentioned repeatedly and insistently that many of the necessary changes for the better future of higher education must take place in teachers; in their training, the development of their skills, and in their acceptance of a role switch congruent with changes in the environment.

Hypotheses regarding the instructors were as follows:

B.2.1. Further work is needed in the issue of teaching training for university teachers.

B.2.2. It is necessary to develop teaching skills in instructors. This includes the following competencies (following Epping, 1998):

B.2.2.a. Technical skills, including basic elements that remain valid over time, and variable elements that must be continuously updated

B.2.2.b. Skills 'in the art', such as continued professional development, knowledge and experience about cognitive and emotional requirements along with demands in the workplace changes in skill requirements and labor market forecasts.

B.2.2.c. Teaching skills, related to methodology; didactics; and social, emotional, and communicative skills.

B.2.2.d. Skills in self-learning, in the sense of the ability and willingness to continuously improve, to have new learning experiences, to self-test difficulties and resistance, and to test strategies and techniques of learning.

B.2.3. It is necessary that the university provides teachers updates on the most recent trends in higher education.

B.2.4. It is additionally necessary that teachers place the student as the first priority in order that they might make evident their teacher professionalism (to carry out his activity with relevant skills and dedication).

B.2.5. To develop educational professionalism, according to the following definition: "A person acts professionally in the educational field when she/he builds a professional identity based on the values of the profession; when she/he is sure of its pedagogical repertoire to perform work tasks; when she/he is able to communicate with itself and with colleagues in an appropriate technical language; when he/she is able to scientifically justify their activities and, of to take personal responsibility for the consequences of their actions within the framework of her/his professional actions in their influence field " (Bauer 1998, p. 346).

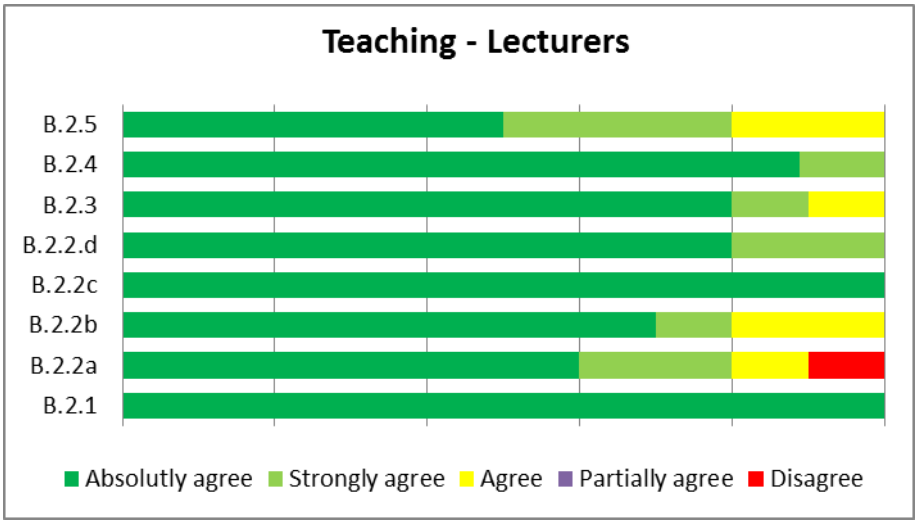


Figure No. 27 *Degree of agreement for the hypotheses B2 Teaching dimension (Lecturers/Instructors)*

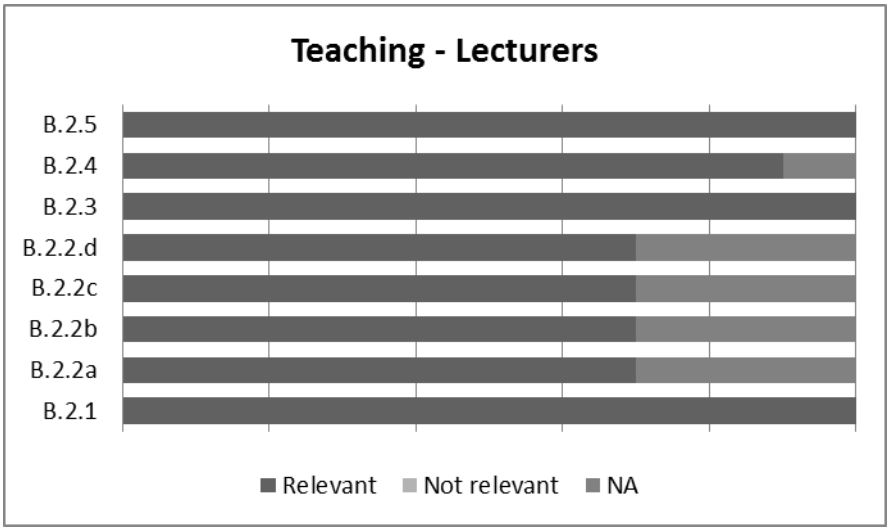


Figure No. 28 *Relevance for the hypotheses B2 Teaching dimension (Lecturers/Instructors)*

Again we can see a clear consensus in the relevance as well as in the degree of agreement. The only one disagreement was related to the skills 'in the art', where someone argued that instructors should have this skill before working in the university system, and that the university should provide existing educators the opportunities to update it. However, this is not contradictory with the hypothesis, but just a remark about what skill should be a prerequisite for working at university.

Additional suggestions in this topic were:

- To demand greater involvement from lecturers in research and extension, and that they constantly update their knowledge in their field
- To strengthen ethics in the professional fields
- To develop social sensibility, solidarity, and respect for socio-cultural diversity
- To make every single lecturer primarily responsible for his/her qualification, even if the university provides opportunities for training and updates

Some important comments are presented below:

> *"In Honduras, lecturers do not have the opportunity to be trained in adult education topics or higher education pedagogy. Just few lecturers have been prepared in that direction. Moreover, the role that the lecturer plays affects the performance of students".*

"Lecturers should have the capability to anticipate the use of tools that could be attractive for students".

"There are not stimuli for the teaching activity. The improvement of the teaching quality relies on the personal interest of each lecturer, which frequently produces unsatisfactory, ancient teaching practices".

"Students are moving into a new environment (digital era), and the form of communication in these environments is not in the language of lecturers, sometimes it is not understandable for him/her. However, they insist on staying in their methods. Better generational communication is in great demand at universities nowadays".

"Lecturers need to be innovative and creative instead continuing to repeat the same strategies that have been apparently functional in the past. Otherwise, the learning process will not be improved. Teachers need to change".

CURRICULUM

The third element mentioned in the teaching dimension is the curriculum. Experts agree that most of the changes necessary in the teaching dimension should take place in the curriculum, including both methodological and content modifications.

The character of flexibility that arises as an important consideration related to the curriculum, introduces different aspects, as the hypotheses B.3.1 (a, b and c) pose:

B.3.1. The curriculum should be flexible in the following aspects (pensum, contents and methodology):

B.3.1.a. The pensum: students should be able to choose how to organize their subjects (to organize their own curricular network).

B.3.1.b. The contents: students and teachers should be able to suggest relevant contents in each subject/career.

B.3.1.c. The methodology: students should be able to attend lectures face-to-face, distance, online or a combination of them all.

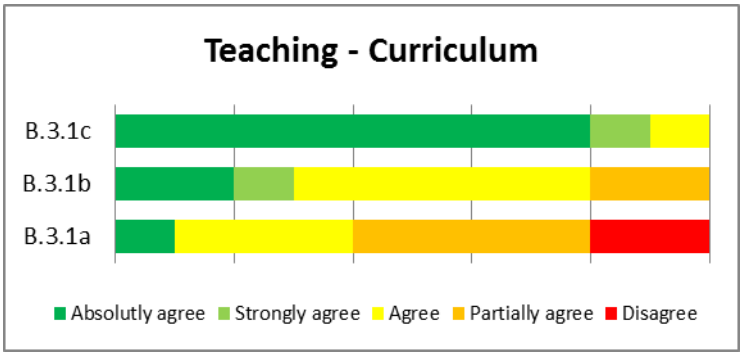


Figure No. 29 *Degree of agreement for the hypotheses B.3.1 Teaching dimension (Curriculum)*

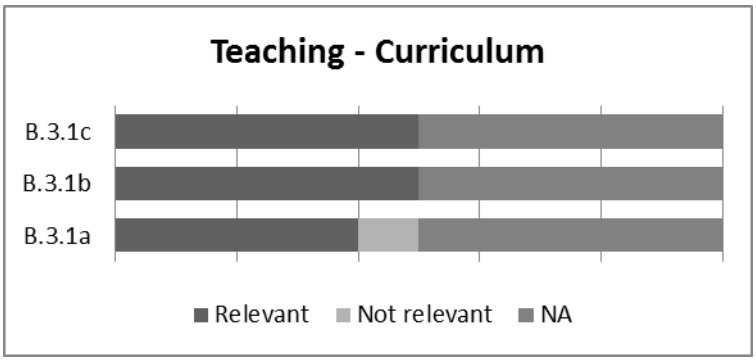


Figure No. 30 *Relevance for the hypotheses B.3.1 Teaching dimension (Curriculum)*

As we can see in Figure No. 29, the answers of experts come to a consensus regarding the flexibility of the curriculum in its different elements. While they strongly agree about the flexibility in methodology, they are more skeptical of the flexibility in the curricular network structure. The few dissenting arguments under these hypotheses are related to the risk of having extremely flexible conditions that could eventually lead to an uncontrolled situation. There are also some concerns about the limitations in alternative methodology; as online programs are not officially permitted according to the higher education law in Honduras, the flexibility in this case is, at the present time, impossible.

Contents

Experts suggest an education that is more focused on developing personal skills than on teaching. Knowledge should be pertinent (according to the context and the actual situation) rather than purely scientific knowledge, and the development of cognitive skills should be emphasized over memorization.

Specifically suggested hypotheses were as follows:

B.3.1.1. Regarding education in values: education needs to cross the barrier created by teaching and learning, and build models based on ethical values towards society and the state, such as responsibility, honesty, loyalty, social awareness, citizenship, discipline, earthly identity and respect to the environment.

B.3.1.2. Pertinent knowledge includes:

B.3.1.2.a. Education for employment
B.3.1.2.b. Knowledge up to date
B.3.1.2.c. Not just the disciplinary fields, but also multidisciplinary and trans-disciplinary approaches.

B.3.1.3. Regarding cognitive skills, future education should bequeath students with the following skills:

B.3.1.3.a. To face and solve problems
B.3.1.3.b. Self-thinking (thinking by oneself)
B.3.1.3.c. Analytical skills with systemic view of the own reality
B.3.1.3.d. Management of information
B.3.1.3.e. To interpret and build theories

Consensus is clear in these hypotheses, as we can see in Figures No. 31 and No. 32. Especially important is the consensus regarding education based on values that are related to the difficult situation faced by the country presently. This topic will be discussed later.

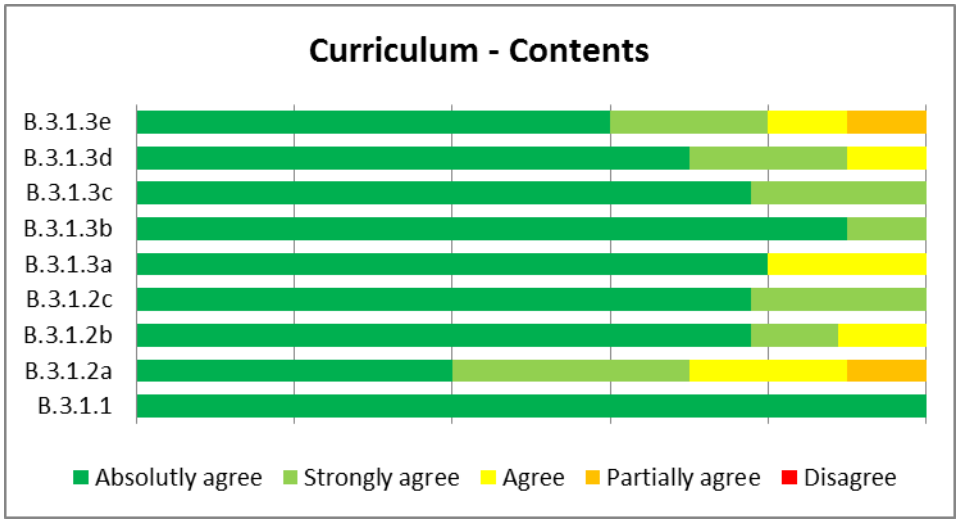


Figure No. 31 *Degree of agreement for the hypotheses B.3.1.1 Teaching dimension (Curriculum - Contents)*

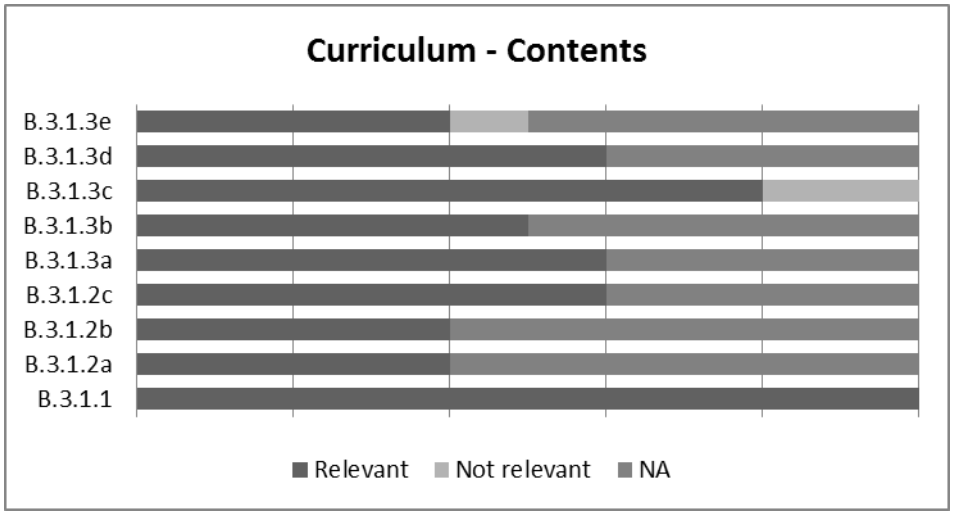


Figure No. 32 *Relevance for the hypotheses B.3.1.1 Teaching dimension (Curriculum - Contents)*

Important remarks of experts in this area are presented below:

> *"A strong motivation for students is the possibility to apply their acquired knowledge. It gives meaning to the contents. It diminishes the gap between theory and praxis".*

"Students learn what we offer them, and our offer is not satisfying their demand. We need to give them tools for life; a curriculum with transversal axes. Learning to learn as well as learning to "unlearn" should be taught at universities".

"The curriculum should be oriented towards skills development. Contents should be meaningful for students. They should learn on the basis of their interests".

"Education cannot be seen anymore as it was conceived by the Napoleonic University. Declarative knowledge is important, but some subjective aspects should be also considered, i.e. peaceful coexistence and social improvement, rationality and decisions making".

Methodology

The methodology is the second element of the teaching dimension regarding the curriculum. Methodology is mainly related to the educational or pedagogic approach. Until now, universities have mostly been acting on an academic freedom philosophy (the Humboldt university) that allows lecturers to choose and adopt their preferred method. However, they are currently making efforts to structure a pedagogical model as institutional guidance for good practice. Expert's hypotheses were related to the paradigm to be used for a better university in the future as follows:

B.3.2.1. The constructivist model should be used as teaching model.

B.3.2.2. A good university cannot hold on to a single model. An eclectic model that permits the combination of different models according to the necessities of each discipline should be adopted.

B.3.2.3. It is necessary to wait for the completion of a few studies in neuroscience in order to identify the better learning strategy of university students.

B.3.2.4. The model to be used should be adapted and contextualized, and should not be imported from a different context where it has been proven.

B.3.2.5. It is necessary to incorporate information and communication technologies in the improved methodology.

B.3.2.6. Graduates of a university that manages knowledge should get not only grades, but also a resume that shows their professional experiences, and facilitates entry into the labor market.

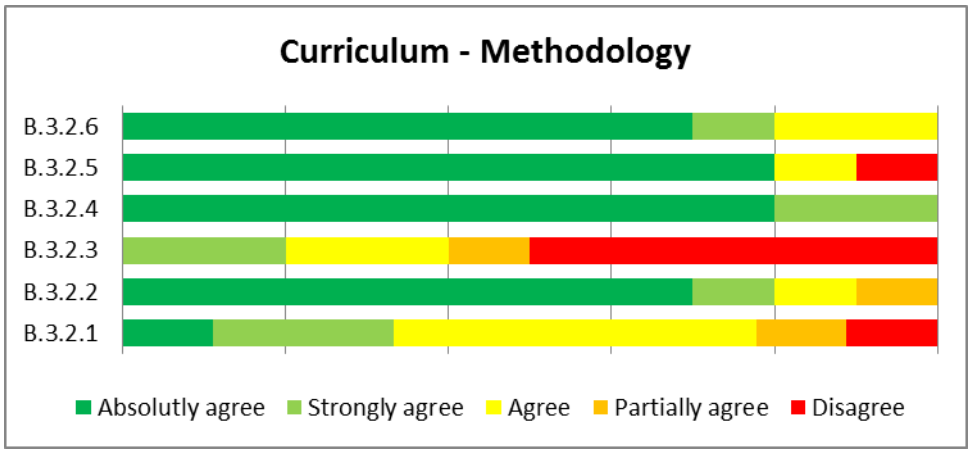


Figure No. 33 *Degree of agreement for the hypotheses B.3.2 Teaching dimension (Curriculum - Methodology)*

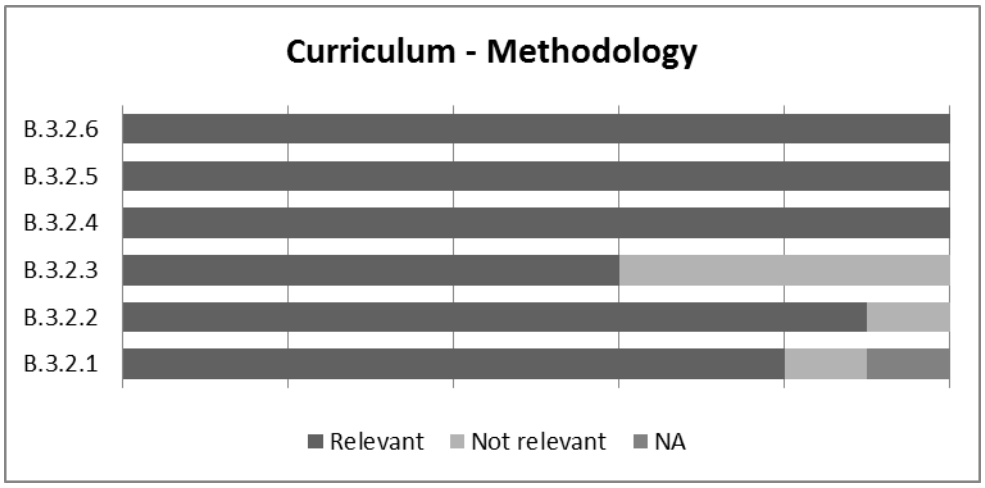


Figure No. 34 *Relevance for the hypotheses B.3.2 Teaching dimension (Curriculum - Methodology)*

As experts mention, the teaching methodology used at Honduran universities is a very traditional one. To move towards the future, it is necessary to train instructors and lecturers in new methodologies. Even though there is some sympathy towards constructivism, experts strongly consider an eclectic model as the best for a good university; some of them express skepticism about constructivism as the best methodology for all disciplines.

Interestingly, opinions about the contribution that neurobiology could provide are divergent. The comments made in relation to the hypothesis on neurobiology do not doubt the importance of this science to education, but reject the idea of waiting for knowledge that seems to be far from being available for educational science. Waiting is indeed an attitude that is dangerous for improvement. The recommendation is therefore to try new models, to develop the own ones if possible, and to be ready to introduce the results of neurobiology sooner than later.

Experts welcome the incorporation of information and communication technologies into methodologies, although some of them insist on improving the old practices before introducing new ones. In this case what it means to use new technologies is often misunderstood, based on the fact that some teachers simply replace the traditional blackboard with PowerPoint presentations.

Last but not least, experts mention the risk of having methodologies that differ greatly from other higher education institutions on the national and international level in terms of recognition of studies.

Some special remarks regarding this are:

> *"Prolonged waiting is what makes our country what it is. Different contexts and different realities need different approaches."*
>
> *"The results of neurobiology research will be a huge contribution to improve learning, but it is not necessary to wait for them".*
>
> *"The use of information and communication technologies is also important for lifelong learning".*
>
> *"Learning through experience and learning through lectures should be in balance".*

RESEARCH DIMENSION

There is a clear understanding that knowledge production is one of the major missions of the university, and that it is achieved through the research process. In this mission, the experts identified four major elements: the researcher, the object of research, policy, and the financial aspect. The assumptions in this mission are presented below.

C.1. It is necessary to train and develop research skills in lecturers.

C.2. More efforts are necessary in systematization and publication of results.

C.3. Contextualization should accompany research; i.e., research should be significant, and not just pure science.

C.4. The government and/or the university should outline their investigative interests.

C.5. The research investment should pay off in tangible assets and institutional/national progress.

C.6. An innovation and research policy in science and technology is necessary at the national level.

C.7. Research should be extended to humanities, including topics of culture and society.

C.8. Research should count as a full time activity.

C.9. A bridge is required between university and society. This is critical, because societal needs and problems can be converted into research objects to be investigated by universities.

C.10. Research should follow a well-defined policy that responds to the needs of the country, is relevant for development, is enacted for the service of society, and contributes to the business sector and the country's productivity.

With these assumptions made into realities, research would then focus on the capabilities and policies necessary to have a well-adapted program with high meaning to the Honduran society, and optimal use of the scarce budget available in our country for this purpose. Agreement on the suggested hypothesis is again clear, as well as the opinion about its pertinence (see Figure 35 and 36). However, experts insist that applied research is a good complement to theoretical approaches, and its relevance varies according to the field of study. It is extremely relevant in teacher education.

Moreover, regardless of whether the policies are set by the state or by the institution, the most important thing is to look for answers to national problems and necessities of society. In a society fraught with social, economic, political, environmental, educational, and many other problems, opportunities for research are omnipresent.

In 2009, the Honduran Congress approved a proposal to develop a national plan, and as a result of the proposal the document "Vision de País 2010 – 2038" (Vision of Country 2010 – 2038) was prepared in 2010 (see Chapter II). This document presents the national goal to be reached by 2038 (in seven governmental periods) in ten strategic guidelines. Experts also agree that research projects and activities should merge efforts to achieve the goals in the different fields of the "Vision de País 2010 – 2038." In order to complement these strategies and make explicit the corresponding investigation needs, it is suggested a National Plan of Research. It would contain the policies regarding the responsibilities for researchers and institutions. It will also be important to capture the international cooperation and investment in Honduras.

It is also recommended keep the link between the national reality and international phenomena in sight. In this manner, results could be extrapolated to other situations around the world.

The revenue that research would provide is considered important by experts, but not the sole value of research. Non-tangible research is also important for the country, such as the investigation conducted in the fields of culture and politics.

The small disagreement observed in C.8 is related to the academic load assigned to researchers. Experts suggest equilibrating the two; not having full-time researchers, but employees that split their time between teaching and research. Moreover, they say that having full time researchers would contribute to the mindset of the academic elite which might lead to a disconnection between researchers and what is happening in the classroom, and therefore to a decontextualization. Congruently, the relevance for this hypothesis is not uniform; some experts do not consider this aspect as something relevant without giving any further explanation.

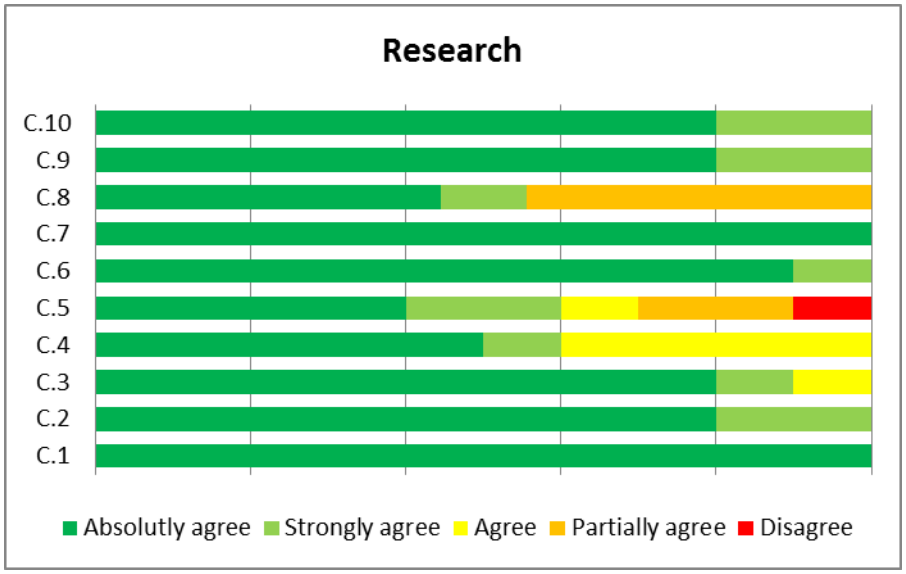


Figure No. 35 *Degree of agreement for the hypotheses C to the Research dimension*

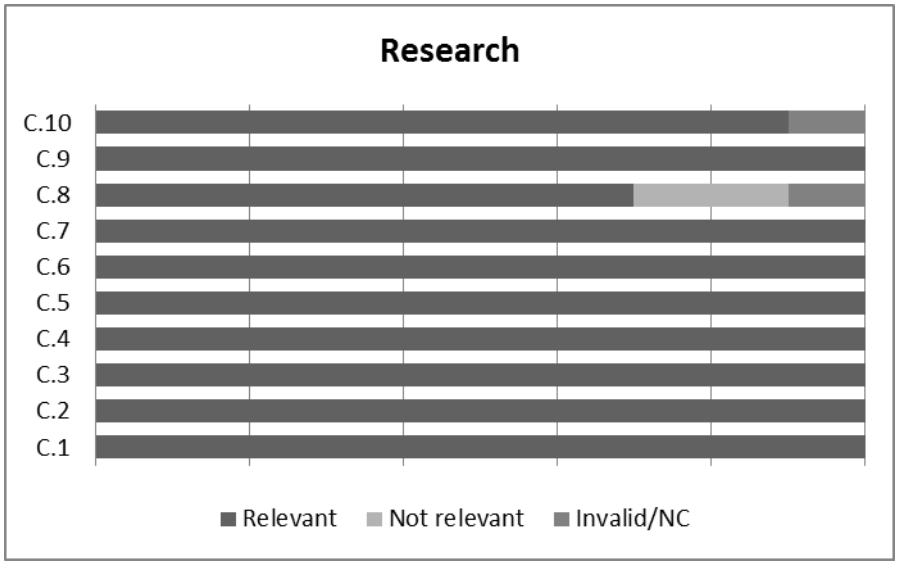


Figure No. 36 *Relevance for the hypotheses C to the Research dimension*

EXTENSION DIMENSION

This mission is distinctively set within the context of Latin American universities, and it assumes that universities bear some responsibility for contributing to the development of the country. The assumptions of experts in this regard are presented below.

> *D.1. It is necessary to highlight the impact of activities outside the university by joining efforts to take care of national poles by intra and interdisciplinary work, and through multidisciplinary projects.*
>
> *D.2. The entire dermis of university must be sensitive in identifying the needs of society in order to reduce inequalities.*
>
> *D.3. To develop a sense of service in different careers and to encourage students' willingness.*
>
> *D.4: Universities should consider a rapprochement to business and country's productivity as an element of their institutional extension policies.*

Extension has been a traditional component of many careers. Many disciplines, such as medicine, advocacy, dentist, psychology, and so on, have social service as an important component of their activities. Students need to have experience in social service as a graduation requirement consisting of around 800 hours working with social disadvantaged groups.

However, experts say that as for research, specific policies and guidelines should be developed for extension in the national level in a coordinated way to avoid wasting resources and time.

Surprisingly, extension was not the most recalled university mission even though its relevance for social development is absolutely clear.

Consensus is clear again, not just with the agreement on hypotheses, but also with the valorization of relevance for each hypothesis as we can see in Figure No. 37 and No. 38.

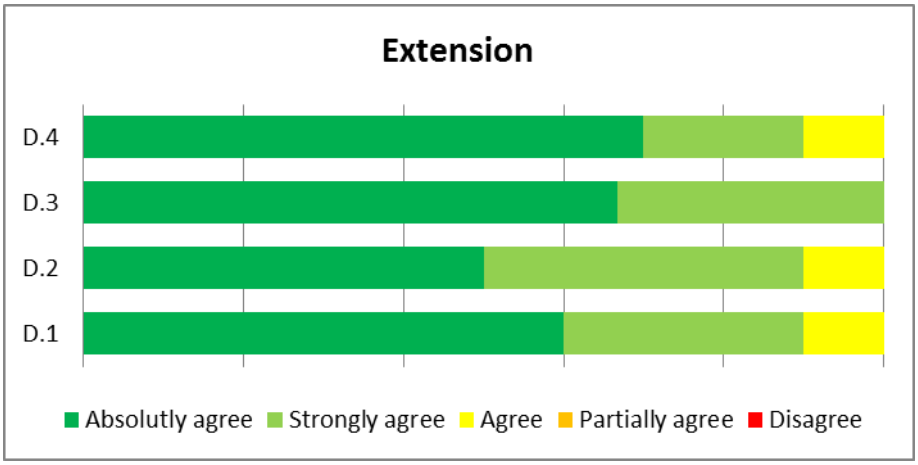


Figure No. 37 *Degree of agreement for the hypotheses D to the Extension dimension*

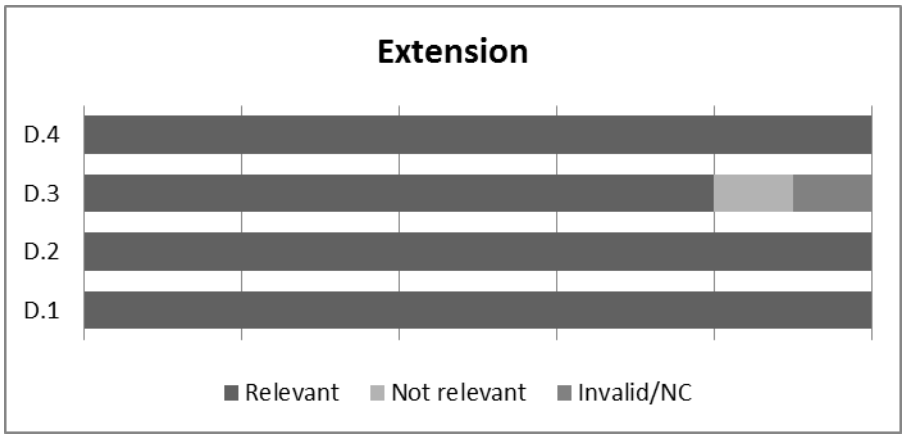


Figure No. 38 *Relevance for the hypotheses D to the Extension dimension*

ADMINISTRATIVE MANAGEMENT

More than a mission, administrative management is the gear that allows university its dynamic; it is an implicit task inherent to every institution. As the hypotheses formulated by experts reflect, many of the necessary changes in the three main missions are only possible if some changes and/or adjustments in take place in administrative management. As it can be seen in the following hypotheses, the most relevant issues are those that relate to change management, knowledge management, national and institutional policies, leadership, and networking and vision:

E.1. It is necessary to make higher education institutions aware of the dramatic changes that are being considered by the societies across the globe, and assume the role they should play is about change.

E.2. Universities should have some academic autonomy; they must be able to generate proposals, and respond to changes in the environment.

E.3. Knowledge management is necessary to produce proposals for change, and implement them.

E.4. Universities, as educational institutions, should have a vision of future, and should be able to anticipate changes; they should be able to act in a way that is purposeful and not reactive.

E.5. The university and its personnel build knowledge, but it is necessary to apply knowledge in a way that continues building on its base. Otherwise, time will be wasted.

E.6. In the future, acquiring and accumulating knowledge should be the basis of improvement and innovation.

E.7. It is necessary to coordinate the activities performed by universities in order to avoid any repetition that would result in the double use of efforts and resources.

E.8. Universities manage knowledge; it is the primary institutional resource. However it is necessary to make a strategy for explicit knowledge management,

E.9. Universities should be autonomous in their strategies for knowledge management.

E.10. It would be ideal to create a department for the sole purpose of explicit knowledge management.

E.11. It is necessary to train directors in leadership skills to have vision towards the future.

E.12. Leadership in higher education should be shared by all universities within the system.

E.13. Networking is a feature of the future university; a single university is no longer self-sufficient. It is necessary to share academic, research, and extension spaces, and to promote exchange with similar institutions.

E.14. Constructing a mission and vision of higher education in Honduras would be an enable of future. The mission would include a new vision and a long-term vision that are closely related to the vision of the country. It should be periodically evaluated and reoriented in scope.

E.15. To this, higher education institutions need to work in a coordinated and synchronized manner that is oriented towards achieving the goals of the shared vision.

E.16. It is necessary to analyze the stakeholders and the partners involved in order to go further. Universities sometimes play a role in generating national problems; they thus have roles and responsibilities to overcome the national crisis.

E.17. It is very important for universities to generate funds and identify funding opportunities. To this end, it is very useful to have a department dedicated exclusively to international cooperation and institutional development.

E.18. The systemic approach should be an administrative strategy to better guide decision making regarding the commitment of the institution to society.

E.19. Universities have failed to prepare past generations to take over the instruction of the future generation; both in teaching and investigative work, as well as in the administration.

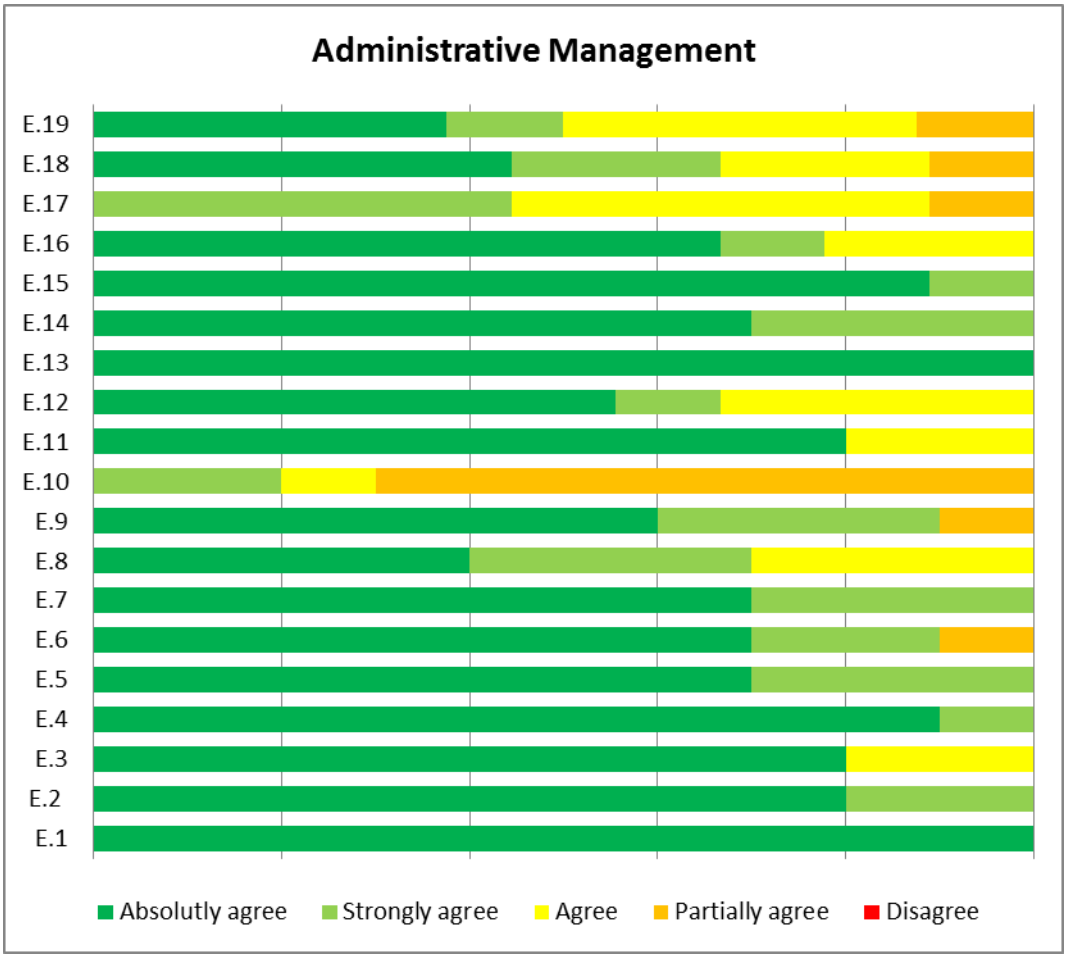


Figure No. 39 *Degree of agreement for the hypotheses E to the Administrative Management*

The topic of autonomy came again to the table. There is consensus about the necessity of each higher education institution to be autonomous, mainly in terms of academy. However, there are also some concerns regarding the limitation of each institution's responsibility to offer high quality careers. Some remarks were made about the limits or implication of autonomy to avoid the confusion with isolation. Experts suggest that networking is also important in the future university; it is considered a good strategy to manage knowledge.

Given that the concept of knowledge management and its application is not clear enough in higher education institutions, the strategy to cope with this process is still unclear among experts. For some of them, it would be helpful to have a department in charge of knowledge management, but for others it will increase the amount of bureaucracy and, possibly, ineffectiveness. Moreover, some consider this issue as a gear moving the whole

dynamic at the university, and therefore it cannot be conceived as a specific task of a specific department. The hypothesis E.10 regarding this is the only one where consensus is on the side of disagreement.

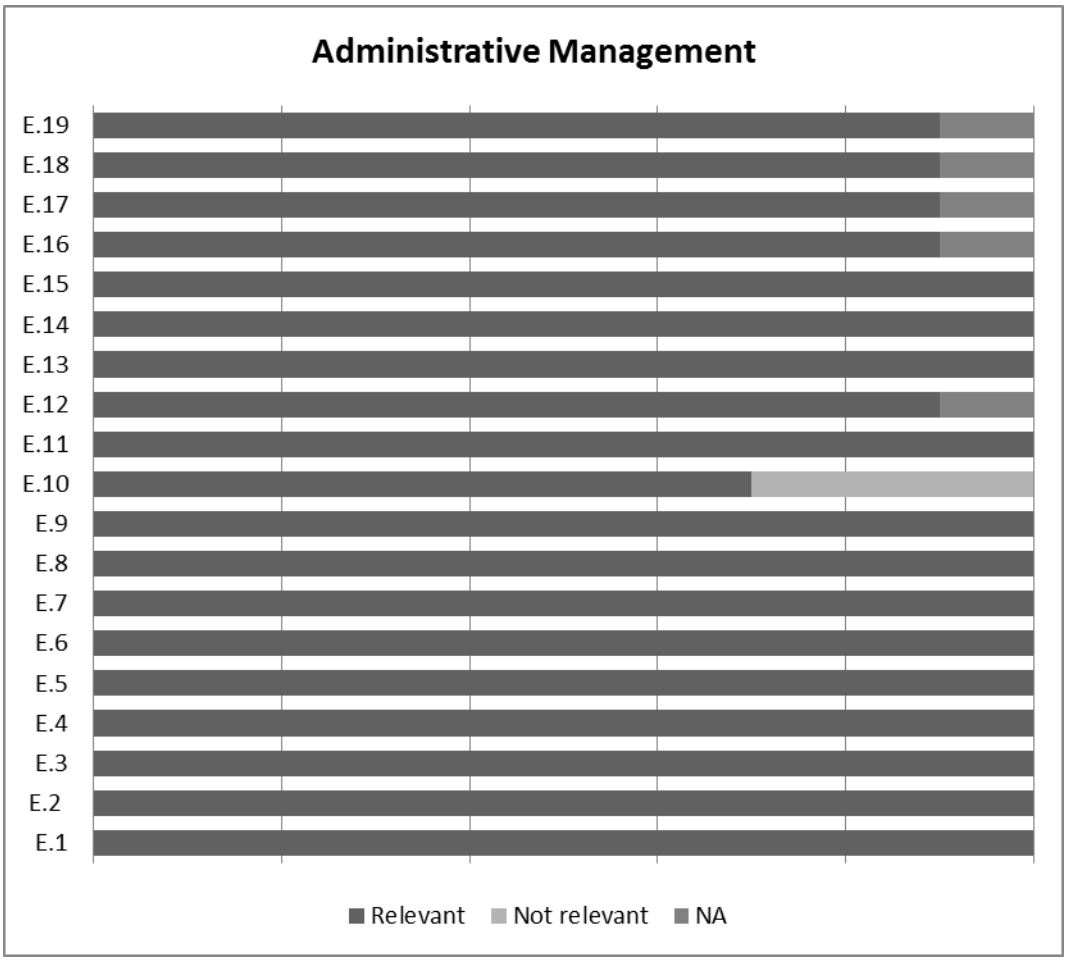


Figure No. 40 *Relevance for the hypotheses E to the Administrative Management*

Leadership is clearly a necessity in higher education institutions, but it is also necessary to define the profile of leaders, and the kind of leadership. Leaders, according to experts, should be specialists in the field of education and research; they should know about science, cognition, and values. At the institutional level, leadership should be shared. It is not at the present time, as leadership is restricted to the UNAH according to the law of higher education.

THE EXTERNAL DIMENSION OF UNIVERSITY

How does the work of universities relate to a larger context? Experts mentioned over and over again that universities cannot be an island in society, much less be indifferent to the needs and realities of the country. The university is and should be an important element of country development, and must fulfill its role through its three main missions. Because of this, the role of the context arises repeatedly in a university's life, as it is evident in the hypotheses presented below.

III.1. It is necessary to define a country's educational model in conjunction with its mission; vision; and psychological, educational, and sociological foundation; but not necessarily a single pedagogical model.

III.2. Institutions of higher education need to create spaces for dialogue with external entities; this would allow them to constantly review their role in society.

III.3. It would be helpful to put aside the individual interests of each institution and to identify us as a single unit for the good of the future of higher education, and the development of Honduras.

III.4. Higher education institutions should be attentive to the national reality. They must generate useful information to decision makers, and propose contributions to society.

III.5. The university of the future is the one that …

III.5.a. … is inserted in the process of solving problems in society.

III.5.b. … is linked to the country's agenda.

III.5.c. … researches and proposes changes.

III.5.d. … has a local vision without losing sight of the international perspective.

III.6. To meet current and future needs, university must overcome the entrenched schemes in undergraduate education. These must be maintained and must be of good quality, but should not stay in a horizontal standard. It should seek a vertical educational to have an influence on what is happening around the country.

III.7. University must be permanently under self-assessment, and external evaluation processes. This will enable them to become aware of the need for permanent transformation.

III.8. Institutes/Accreditation agencies are required, and universities must undergo the accreditation process.

III.9. Under the understanding that quality is what matters, institutions must:

III.9.a. redefine schemes
III.9.b. redefine models
III.9.c. re-orient postgraduate studies
III.9.d. recycle teachers
III.9.e. strongly work the topic of relevance

Regarding the externalities, consensus appears to be clear again. The role that higher education institutions should play in the development of the country is not debated. Experts agree about the necessity of incorporating the Vision of Country to the institutional plans, and to adapt and re-orient the objectives, mission and vision of each university if necessary to closely cooperate to the national plan.

Quality assurance is not debated either. Given that at the present time there is not an institution in charge of accreditation, some concerns were expressed by experts related to the creation of such organism. On the one hand, some remarked on a few disadvantages, such as the possibility that an accreditation institution would increase bureaucracy, or the cost of evaluation processes would unfairly hurt public institutions. On the other hand, the nature of those institutions entails that they should be independent of any already existing institution and ensure excellence. Moreover, they should be autonomous and have enough authority to control and monitor the function of higher education institutions, while offering help to institutions that do not meet minimal quality standards at the same time. By the time this research was conducted, the law enacted to create Quality Assurance Agencies was already approved, but not implemented.

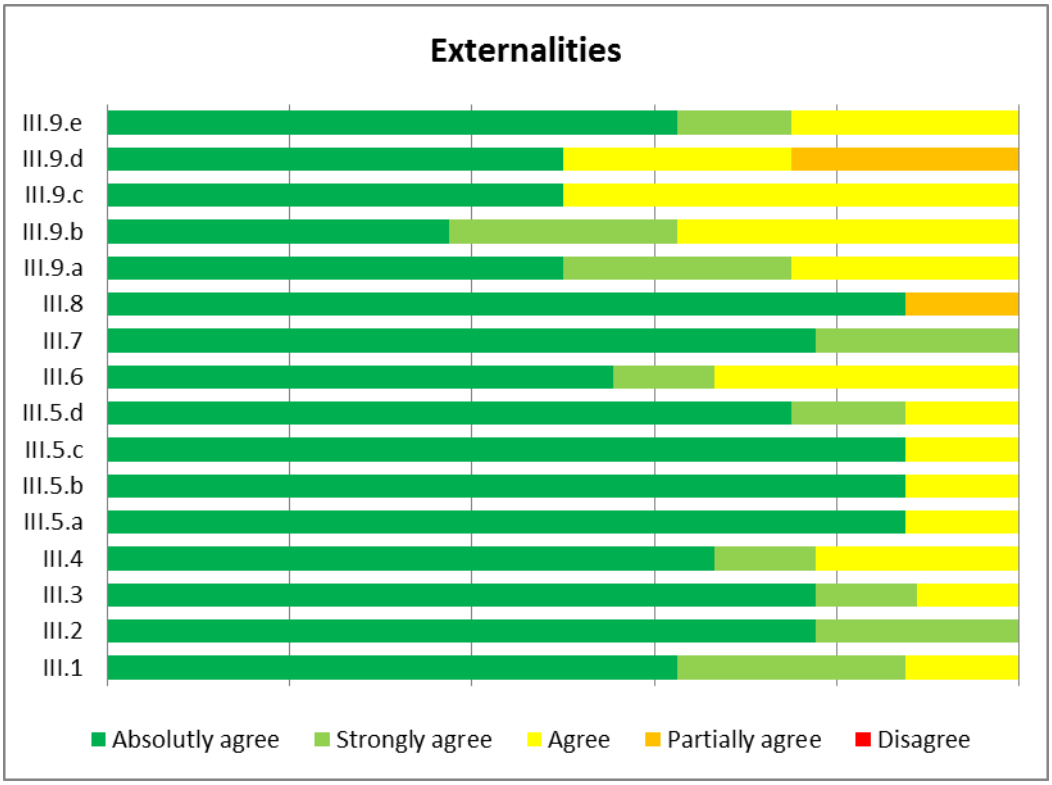


Figure No. 41 *Degree of agreement for the hypotheses III to the Externalities*

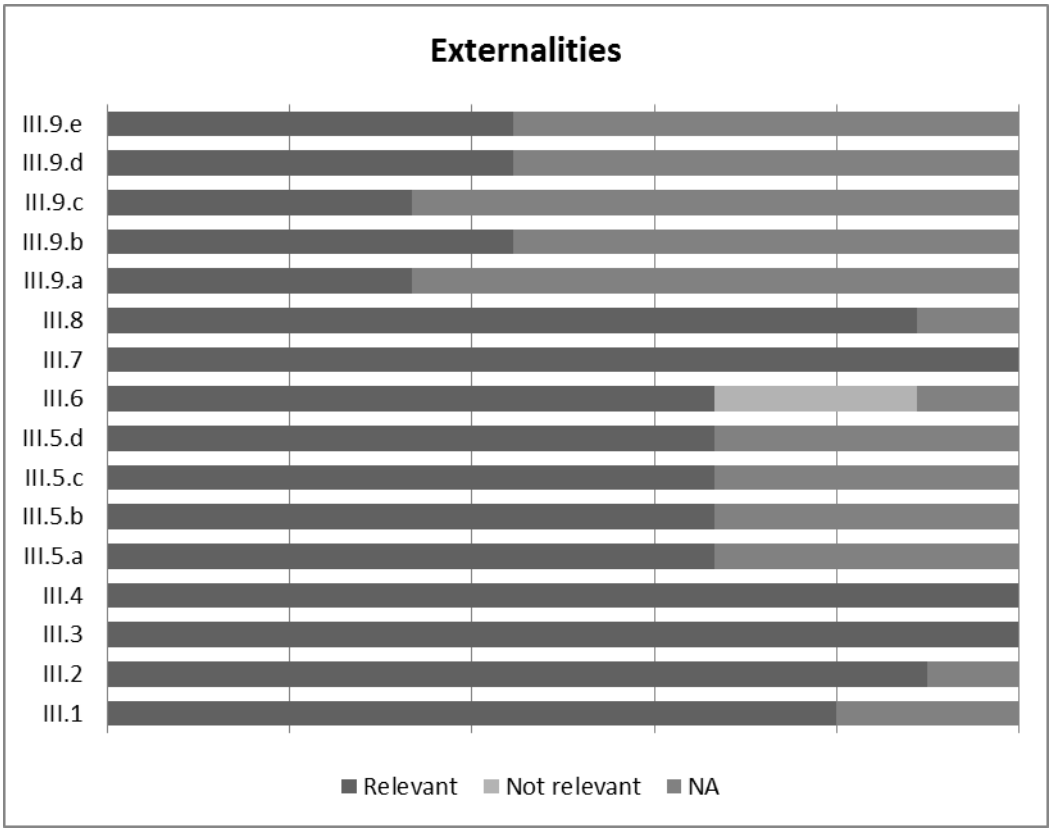


Figure No. 42 *Relevance for the hypotheses III to the Externalities*

GENERAL OVERVIEW OF EXPERTS OPINION

As stated before, the Delphi Study took two rounds. The first round collected experiences and opinions, but not all of them were directly related to the purpose of the study. An overview of the categorization of opinions during the first round is presented in Table No. 8. Categories were filtered and clustered to enter the second round; just the relevant hypotheses were then used for the second consult.

A general overview of the results for the second round is presented in Table No. 9. Eighty nine hypotheses were derived from the first round. For eight of them consensus regarding the level of agreement seems to not be clear (see hypotheses A.2; B.1.2; B.1.3.a; B.1.3.c; B.1.3.e; B.3.1; B.3.2.3 and C.8). For relevance, just one hypothesis has equal weight for relevant and not relevant (see hypothesis B.3.2.3).

Consensus was on the side of agreement with just one exception. On E.10, experts disagree about having a specific unit to manage knowledge at the university, arguing that it should be an implicit task of the institutional culture.

Relevant issues of both rounds are presented in the tables below.

Table No. 8 *Categories for each question after the content analysis of interviews (Delphi's first round)*

QUESTION 1	QUESTION 2	QUESTION 3	QUESTION 4	QUESTION 5	QUESTION 6	QUESTION 7	QUESTION 8	QUESTION 9	QUESTION 10
The present of HE	**Teaching**	**Management**	**Teaching**	**The future of HE**	**Research**	**Extension**	**Management**	**KM**	**Relevant Knowledge**
1. Lack of institutional decision	1. Deficiencies on basic and secondary schools	1. Lack of institutional decision	1. Lack of institutional decision	1. Lack of institutional decision	1. Obstacles for research	1. What is extension in Honduran universities	1. Management in compartments	1. What is Honduran university	1. About cumulative knowledge
2. Deficiencies of students	2. Deficiencies in lecturers skills	2. What is missing/ What is needed	2. Deficiencies in lecturers skills	2. Teachers as obstacles	2.What to do	2. Well done	2. Need for a systemic approach	2. Deficiencies in lecturers skills	2. To apply knowledge
3. Postgraduates/ Research	3. Curriculum	3. What has changed	3. What we have in the present	3. The conception of an ideal	3. What kind of research	3. not well done	3. Need for a common vision	3. What is needed	3. To systematize / Documenting
4. Supply/Demand	4. Competencies	4. About change	4. Lack of follow-up strategies	4. Country vision	4. What we have in the present	4. What to do	4. Leadership	4. The knowledge business	4. Learned lessons / Good practices
5. External Factors (High Schools/Socio-economic factors)	5. Teaching methods	5. Lecturers skills	5. Obstacles/ Limitations/ Opportunities	5. Education as strategy for development	5. Perception at university	Knowledge transference	5. Others	5. Knowledge production/Research	5. Accreditation / Quality
6. Higher education as strategy of development	6. Factors influencing performance	6. Networking	6. Pro - Constructivism	6. Problems/ Gaps/ Alternatives	6. Others	6. Decoupling/ De-contextualization	a. Re-structuring the whole	6. Others	6. Need to join / Regulation of HE
7. Quality assurance	7. Lack of previous related studies	7. Knowledge management	7. Research	7. Lack of policies for HE	a. Weak basic education	7. Relevance of other missions	b. Individualism "I/me"	a. Public value / Merchandise	7. Challenges / Opportunities
8. Problems inherent to the system	8. Motivation/Emotions	8. Research	8. Knowledge management.	8. Features of a satisfactory university	b. Doctorate Programs	8. Problems of Honduran society	c. What is management	b. Change	8. The value of cumulative knowledge
9. Until which extent it serves (Generalities/Individual Level/ Entrepreneurial Level/Society Level)	9. Entrance selection system	9. Obstacles for change	9. Against constructivism (consider other theories)	9. Others	c. Lack of researchers	9. Others	d. Various	c. Entailment	9. Others
10. Lack of previous studies (Uni as object of study)	10. Change	10. Others	10. Others	a. Periodic updates	d. Research skills deficiencies	a. The bachelor science degree		d. Challenges of the 21st Century	a. Change
11. Needs of society/Context	11. Educational Model	a. Cooperation and development	a. Contextualization	b. Learning conditions	e. Teachers training	b. Córdoba movement		e. Free transit of professionals	b. Autonomy
12. What is missing/What is needed	12. Lack of control and follow-up strategies	b. Complexity and multidimensionality	b. Educational Model/Theory of knowledge.	c. Coverage	f. Technical Table of Innovation	c. The actual model		f. Prescriptive model	c. Country problems
13. Problems external to the system	13. The future	c. Lack of implementation	c. Political interference	d. Entrepreneurial fail	g. Innovation	d. Privatization		g. Market saturation	d. Context
14. Others	14. The educational system	d. Dialogue with externalities	d. Coverage			e. Coverage		h. Inter-institutional communication	e. Expiration of knowledge
a. Putsch	15. Others	e. Change resistance	e. Deficiencies in high school			f. Prior levels			f. Various
b. Critic conscious	a. Social Status	f. Entrepreneurial vision	f. To create capacities						
c. Public dialogues	b. Planning	g. Globalization	g. Admission test						
d. Technology	c. Scientific formation	h. Rankings	h. Country development						
e. Internal perspective	d. Standards	i. Quality							
f. Autonomy	e. Academic Networks	j. Market saturation							
g. Basic science	f. Traditional careers	k. Lack of interest							
	g. Integral interventions	l. Productive sector							
	h. Virtual platform	m. Investment in education							
	i. Basic Science								
	j. Institutional vision								
	k. Supply/Demand								
	l. Isolated actions								

Table No. 9 *Summary of answers to hypotheses of the second round*

							DEGREE OF AGREEMENT					RELEVANCE	
PART	SECTION	TOPIC	SUB -TOPIC	QUESTION	POINT	SUB POINT	1 Absolutely agree	2 Strongly agree	3 Agree	4 Partially agree	5 Disagree	YES	NO
II	The internal Dimension												
	A	General Hypotheses											
				1			3	3	3	2	0		
				2			1	4	1	4	1		
				3			6	2	3	0	0		
	B	Teaching											
		1	Students										
				1			4	2	1	0	1	7	1
				2			2	2	1	1	3	7	2
				3									
					a		4	1	0	1	4	9	1
					b		3	0	4	1	2	8	2
					c		3	0	1	4	1	8	1
					d								
						i	9	0	0	0	0	8	0
						ii	8	1	0	0	1	7	0
						iii	8	1	1	0	0	7	1
					e		2	2	0	2	3	7	3
		2	Lecturers										
				1			10	0	0	0	0	10	0
				2									
					a		6	2	1	0	1	7	0
					b		7	1	2	0	0	7	0
					c		9	0	0	0	0	7	0
					d		8	2	0	0	0	7	0
				3			8	1	1	0	0	10	0
				4			8	1	0	0	0	9	0
				5			5	3	2	0	0	10	0
		3	Curriculum										
				1									
					a		1	0	3	4	2	4	1
					b		2	1	5	2	0	5	0
					c		8	1	1	0	0	5	0
			1	Contents									
				1			10	0	0	0	0	10	0
				2									
					a		4	3	2	1	0	4	0
					b		7	1	1	0	0	4	0
					c		7	2	0	0	0	6	0
				3									
					a		8	0	2	0	0	6	0
					b		9	1	0	0	0	5	0
					c		7	2	0	0	0	4	1
					d		7	2	1	0	0	6	0
					e		6	2	1	1	0	4	1
			2	Methodology									
				1			1	2	4	1	1	8	1
				2			7	1	1	1	0	9	1
				3			0	2	2	1	5	6	4
				4			8	2	0	0	0	10	0
				5			8	0	1	0	1	10	0
				6			7	1	2	0	0	10	0
	C	Research											
				1			10	0	0	0	0	10	0
				2			8	2	0	0	0	10	0
				3			8	1	1	0	0	10	0
				4			5	1	4	0	0	10	0
				5			4	2	1	2	1	10	0
				6			9	1	0	0	0	10	0
				7			10	0	0	0	0	10	0
				8			4	1	0	4	0	7	2
				9			8	2	0	0	0	10	0
				10			8	2	0	0	0	9	0
	D	Extension											
				1			6	3	1	0	0	10	0
				2			5	4	1	0	0	10	0
				3			6	3	0	0	0	8	1
				4			7	2	1	0	0	10	0
	E	Administrative Management											
				1			10	0	0	0	0	10	0
				2			8	2	0	0	0	10	0
				3			8	0	2	0	0	10	0
				4			9	1	0	0	0	10	0
				5			7	3	0	0	0	10	0
				6			7	2	0	1	0	10	0
				7			7	3	0	0	0	10	0
				8			4	3	3	0	0	10	0
				9			6	3	0	1	0	10	0
				10			0	2	1	7	0	7	3
				11			8	0	2	0	0	10	0
				12			5	1	3	0	0	9	0
				13			10	0	0	0	0	10	0
				14			7	3	0	0	0	10	0
				15			8	1	0	0	0	10	0
				16			6	1	2	0	0	9	0
				17			0	4	4	1	0	9	0
				18			4	2	2	1	0	9	0
				19			3	1	3	1	0	9	0
III	External Dimension												
				1			5	2	1	0	0	8	0
				2			7	2	0	0	0	9	0
				3			7	1	1	0	0	9	0
				4			6	1	2	0	0	9	0
				5									
					a		7	0	1	0	0	6	0
					b		7	0	1	0	0	6	0
					c		7	0	1	0	0	6	0
					d		6	1	1	0	0	6	0
				6			5	1	3	0	0	6	2
				7			7	2	0	0	0	9	0
				8			7	0	0	1	0	8	0
				9									
					a		4	2	2	0	0	3	0
					b		3	2	3	0	0	4	0
					c		4	0	4	0	0	3	0
					d		4	0	2	2	0	4	0
					e		5	1	2	0	0	4	0

THE MEANING OF KNOWLEDGE AND KNOWLEDGE MANAGEMENT AS REQUIREMENT TO MODEL THE FUTURE OF HIGHER EDUCATION

As stated in Chapter III, Table No. 2, which was presented by Alavi & Leidner (1999) for the first time and then modified by Chen & Chen (2006, p. 19), is an attempt to summarize the different connotations attributed to the knowledge concept of, and the implications of the definition for KM. In a similar way, using the input from the interviews, a content analysis was done to identify the meaning of knowledge for experts, and its implication regarding the different missions of universities in Honduras. This was an emerging, in-course analysis to understand the *raison d'etre* of Honduran higher education institutions, and to justify a new learning approach approach.

THE PERCEPTION OF KNOWLEDGE IN THE FIELD OF HIGHER EDUCATION IN HONDURAS

Universities have been recognized as centers of knowledge; however, after an intensive literature review, it is clear that "knowledge" as object of study has not been relevant for them. During the survey conducted for the Delphi Study, the concept of knowledge emerged 270 times. This input was used to identify the semantics and use of the concept in this specific context. The result is as shown in Figure No. 43. At universities knowledge is conceived primarily as information, secondarily as a human approach (state of mind), and tertiary as an object.

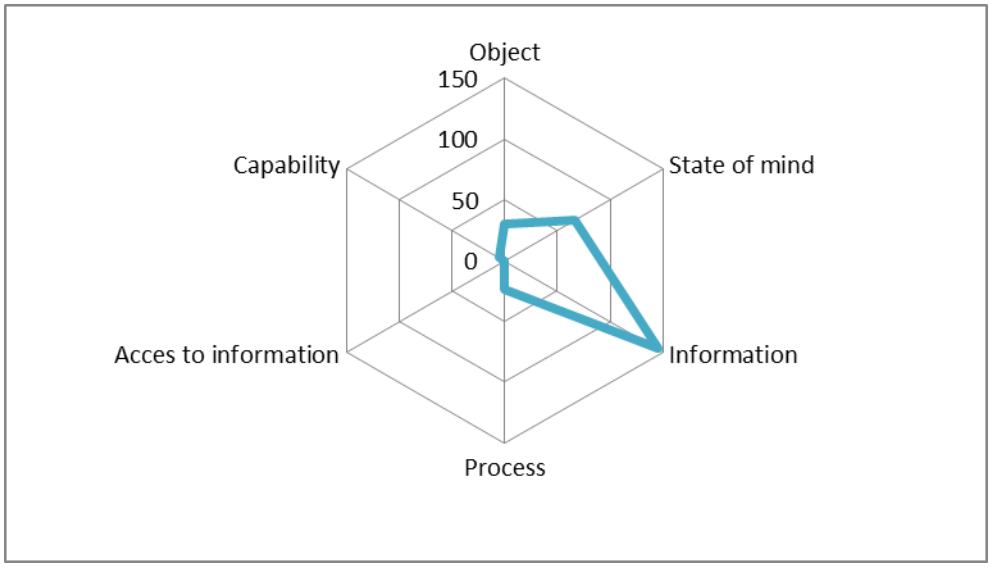


Figure No. 43 *The conception of knowledge*
Results of content analysis (semantic) of experts interviews in higher education in Honduras.

A second analysis was related to the association of the concept knowledge with the different goals of the university (Figure No. 44). In this case, knowledge is highly related to teaching in the sense of transferring information from lecturers to learners. It is also related to knowledge production, termed research, and learning in the sense of the capability of learners to absorb what lecturers have to give. In the two first cases, the informational approach is clear, while in the third case knowledge is related to the mental capability of learners.

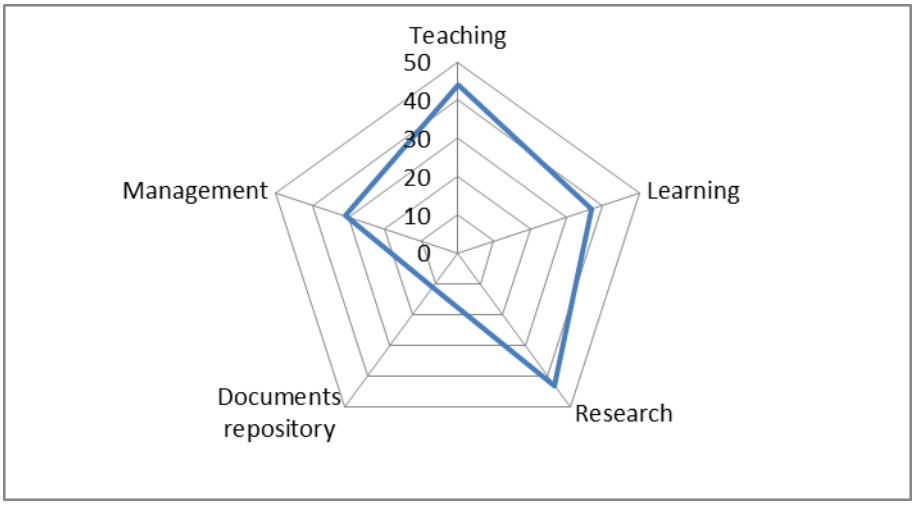


Figure No. 44 *The relation of knowledge with the activities at university. The same source as in Figure No. 43, but in this case is represented the relation of the term "knowledge" with the different tasks at the university.*

Both graphics are a good source for understanding the tasks and goals in higher education. The classification used in Table No. 2 was used to conduct the content analysis of Figure No. 43. The category "Information" was added to the classification, although "Information" could be considered going in "Object." However, it was not always possible to exchange the meaning during the content analysis without losing the sense of the sentence or paragraph. However, both are considered as an "informational" use of the concept, on the contrary to a "state of mind" which is, clearly, merely cognitive.

If knowledge is understood in an informational manner, the main tasks of the university should be teaching and researching. Both activities are possible if knowledge is an object, but this approach is not necessarily correct. This appreciation is confirmed in Figure No. 44. For higher education institutions in Honduras as knowledge centers, the main goal is to transfer and produce knowledge. This is in turn related to the teaching

methodology: a traditional frontal methodology centered in teaching more than in learning. Some comments of experts regarding this are presented as follow:

"A lot is said about constructivism, but in praxis lecturers are mainly behaviorist. We need to move to a new methodology, so that we could compare the effects of different methodologies in graduates".

"We need to check if one of the theories proposed since the 18th century is appropriate for the current moment, with respect to our students and our country".

"Some individuals are making things different, in the direction of constructivism, but the educational system as a whole is not necessarily doing things different".

"No, behaviorism is not more suitable, but is not possible to abandon it from one day to another. However, lecturers need a good understanding about their discipline in order to understand how to apply constructivism. Frontal lectures are not bad, if we remember that the great masters of history like Christ, Buddha or Luther King just to mention a few, have been orators, but they used lectures as center of trigger questions".

"The dominant model in our higher education institutions is behaviorism, recently with some traces of constructivism. This is in turn, the consequence of have been taught under behaviorist conditions. Constructivism is the more appropriate for the present time".

"Our universities have a trend to adopt a scholastic model of knowledge transmission across the years. It is vertical, transmitting from the one who teaches to the one who learns. Universities were born in mediaeval period doing the same thing, and they were born in America after the colonization inheriting the same practices".

"The educational model formulated in 2008 analyzes which of the paradigms are the dominant, and definitively the dominant one in higher education is scholastic. That means that lecturers act to transfer knowledge and students act as passive object".

"We have a mixed educational model, which is highly impregnated with behaviorism".

MERGING BIOLOGY AND PEDAGOGY – The contribution from Neurobiology and Autopoiesis

The conditions for a post-Gutenberg learning culture have been set since the spread of books and the increasing accessibility to knowledge, however higher education institutions remain in many ways as they were in their didactic model: lecture institutions (Arnold, 2011, p. 45).

The questions to learning process and human development have been traditionally sought after with psychological research. However, the idea seeking a novel, integrative approach is not new. Niewels (2004, p. 137) presents a new conception of learning on three emergent levels: ontogenetic, phylogenetic and cultural learning. They can be replaced by a self-referenced system or "learning of genes," "learning of brain," and "learning of a social unity". Another attempt to answer the question from a novel perspective is referred to by (Kovác, 1995), using the concept of "biopedagogy," an old term with many uses. In this case, it intends to link the teaching and learning in the realm of cognitive biology. A similar idea is the prominent theoretical framework of the Bio-Ecological Theory of Human Development, which proposes that human development is influenced by multiple interdependent interactions of an individual with its environment at different ecological levels (Guhn, 2008, p. 339). Wilson, who coined the term sociobiology as the study the social behavior from a biological point of view, brought another similar approach. He said that even if learning is influenced by biological conditions, it has become independent of its origin, and is now determined by the environment and social factors (see Wilson, 1975).

As it is presented in the previous section, learning, and therefore knowledge as a human capability, is closely related, but not reduced to biology. Learning is also cognitive, and takes place in a determined environment where social and cultural factors play an important role.

Following Maturana's and Varela's theory of autopoiesis, knowledge takes place in the individual; it is an internal process in which the teaching can just trigger different responses in different individuals. On the other side, it is also stated that knowledge takes place only in a social context, and language and culture are clue factors for knowledge.

Questions related to the psychology and sociology of knowledge are becoming intertwined with pedagogic questions. While the psychology of knowledge seeks to explain how people are able to acquire and retain coherent and complex information on a lasting basis and how the ways in which knowledge is internally structured assisted the learning process, the sociology of knowledge sheds light on another side of the problem. It examines how society generates knowledge, and this includes looking at the social reasons why interests groups generate and monopolize information (Arnold, 2005, p. 34). In sum, psychology and sociology have been responsible for the development of learning theories in some way, and the role that biology plays has been ignored or underestimated.

The need for changes in the teaching dimension is one clear result of this study. Focusing on that, the answers of experts allow identifying the needs in this aspect in the form of the didactic triangle (Figure No.16) by introducing the identified weaknesses of each element in the Honduran university as shown in Figure No.45.

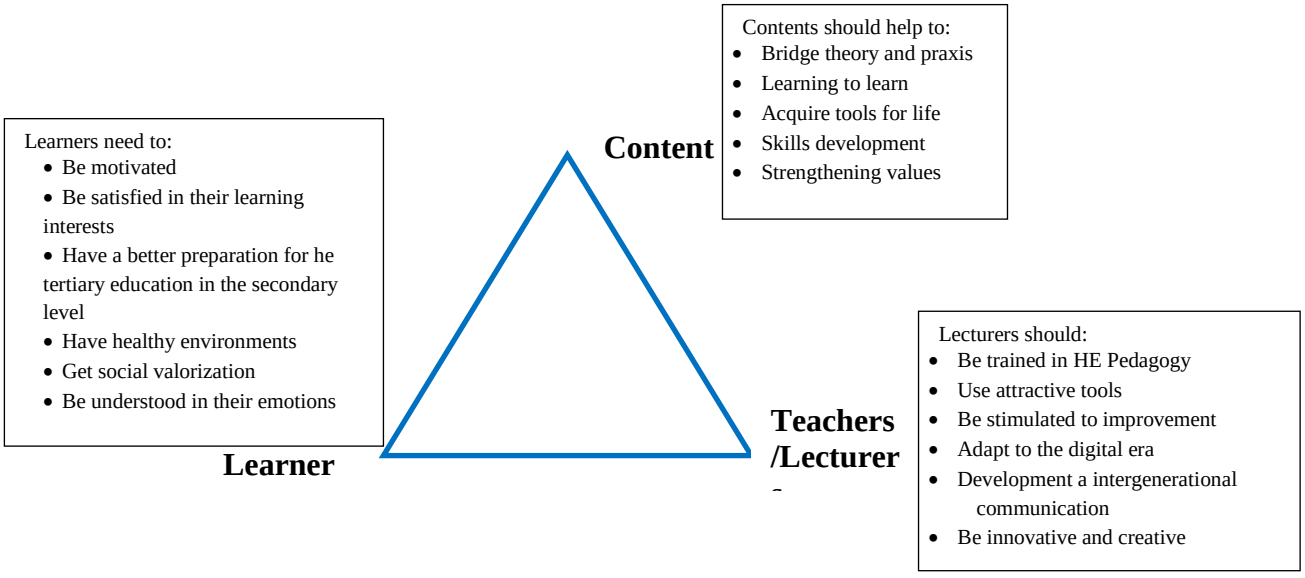


Figure No. 45 *Didactic triangle modified with the answers of Honduran experts (Source: Adapted And modified from Arnold & Pätzold, 2007, p. 95)*

Analyzing the triangle arises the question of how effectively incorporate the biological contribution to improve the learning process.

Therefore, this work proposes to integrate the contributions of biology, psychology, and social sciences to develop a new integrative learning approach. Doing that means to first take the relevant aspects of biology (autopoiesis and neurobiology) and combine them with pedagogy. Next, that social sciences have a great contribution to the process, because, while learning takes place at the individual level in a self-determined way, the learning process takes place through perception of and interaction with the environment, and is a result (and a origin) of culture. Finally yet importantly, the learning capability is a cognitive process in the domain of psychology; the contributions of this field are therefore clear and more than relevant to update the learning – teaching strategies (see Figure No. 46 as summary). We talk of a bio-psychosocial approach.

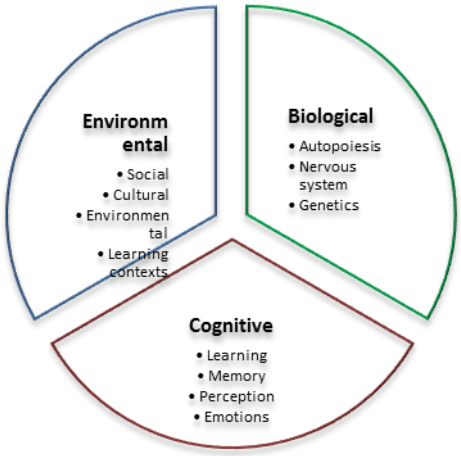


Figure No. 46 *Factors to be considered in a holistic approach of learning process*

As mention before, there is still an open question as to how to effectively apply the results of neurobiology research to educational practice. The development of new technologies to analyze the brain function promises results in the near future that will be of interest for the educational science. In terms of the relationship of educational field with neuroscience, a continuing evolution is foreseen. But we should begin to allow this trans-disciplinary connection.

For some experts, we need to await the results of neuroscience to properly understand the learning process, and therefore to adopt one or another learning theory in higher education (Euceda, 2011). However, most experts do not want to wait; they argue that waiting is harmful for the educational system the suggestion is therefore to move, to try one and another learning theory.

THE FUTURE HONDURAN UNIVERSITY – List of Criteria to be Considered

Based on the opinion of Honduran experts, a list of criteria that should be considered in the future of higher education in Honduras is presented in Table No. 10 as a first attempt to identify our actual position in relation to the desired university. The list was completed with information from the literature review. This list entails the more important parameters for each mission of university. Since there is no one-size-fits-all solution for universities, it does not expect a standardization of criteria. Universities are different according to their funds, their age, their field of specialization, their context, and so on.

Table No. 10 *List of criteria to be considered for the future of higher education*

THE INTERNAL DIMENSION
TEACHING
Students
1. Better academic level to access higher education Since one of the main problems currently is the low level of students entering university, is imperative to improve their level at entrance, to improve higher education. The future university should: a. Re-design the admission test and coordinate its application, as well as to do some research in order to validate its effectiveness. b. Provide opportunities to improve the academic level once students are admitted at the university. This means to propitiate remedial courses, mainly in Spanish, Mathematics and the development of cognitive functions. c. Contribute towards improvement to the level of secondary education by training teachers and improving their teaching capabilities and skills. d. Research and systematize the successes and failures of university students. e. Strengthen motivation and values, as well as healthy learning environments.
Lecturers
2. Improvement and update of teaching skills Lecturers are pointed to time and time again, as the main obstacle to improving higher education. Proponents of this cite change resistance, lack of teaching skills, obsolescence of teaching and discipline knowledge, among others as argument for their position. These deficiencies are not exclusively under the responsibility of lecturers, but also from the institutions. Lecturers of the future university should:

a. Develop teaching skills in an integral form (professional, methodological and personal skills).

b. Develop educational professionalism.

c. Be involved in research and extension

d. Strengthen values (ethics, social sensibility, solidarity, respect for socio-cultural diversity)

e. Continuously update their knowledge on teaching and adult education/learning.

f. Learn and adapt to new environments surrounded by technology.

g. Anticipate changes, and adapt to them.

Curriculum

3. Focus on pertinent knowledge rather than purely scientific knowledge

Experts suggest an education more based on developing personal and cognitive skills than on theoretical content.

An ideal curriculum for the future university should consider transversally:

a. Pertinent/contextualized knowledge

b. Cognitive skills, not just memorizing

c. Professional, methodological and personal skills

4. Education in values

In times when information is available everywhere, experts suggest emphasizing the forgotten aspects related to values and the development of an integral individual instead of worrying about transferring information, which in many cases is obsolete.

5. Educational framework to guide educational strategies

Universities have academic freedom; however experts recommend a frame, in concordance with the national vision. For this purpose an educational model is a good tool, but each institution should choose the educational model that will be applied, and identify its potentials, advantages, and disadvantages according to its profile. The use of an eclectic model is also a possibility, but the institutional level, as well as the individual level (lecturers, professors and also students) should be aware of the results applying one model over another.

Models suggested for the future university are:

a. Constructivism

b. Critical Pedagogy

c. Systemic Pedagogy

d. Eclectic

6. From a teacher centered paradigm to a learner centered paradigm

Ancient practices teaching-centered should move to new modern educational practices, where learning is the center of the whole process. It includes propitiating the better conditions in each

element of the learning process.

7. Flexibility in all components of curriculum

Rigid programs are considered a negative element for good performance in higher education. At the present time, curricula are extremely closed with consequences in low terminal rate, long periods before getting the grade, high dropout rates, high costs for the university, among others.

To better fit the future, curriculum should be flexible in:

a. Contents; students and teachers could suggest relevant contents in each subject/career

b. Methodology; students can combine face-to-face lecturers with distance learning, online learning.

RESEARCH

8. Applied research, context oriented

Each higher education institutions should define its kind of research according to their interests, resources, etc. and at the same time admit the possibilities that each choice could bring to them and how it could help them to be competitive and in the best possible position.

The future university should go beyond traditional research and favor:

a. Multidisciplinar/Interdisciplinar/Transdisciplinar vs. Monodisciplinar

b. Local and National topics

c. Applied vs. basic research

d. Social benefit vs. pure science

e. Creation of research institutes

f. Collective vs. individual

g. Social Science as well as Natural Science

9. Improve research profile of lecturers and researchers

Research is the main gap between universities of more developed and less developed countries. Therefore, for an ideal university it is necessary to train researchers in order to improve research.

Therefore, the future university should ensure that researchers have the following profile:

a. Flexibility and anxiety for cooperation and creation of knowledge networks

b. Foreseen of trends

c. Close and dynamic contact between academy and industry

d. Teamwork capabilities

e. Leadership skills

f. Team management skills

g. Communication skills

h. ICT skills

i. Knowledge of rights and problems related to intellectual property rights

j. Ethics

10. Improve systematization and publication

Experts refer the huge deficit of documentation, systematization and publication.

In order to be competitive in the future, the research dimension of universities should:

a. Always publish the results of their investigation

b. Publish at the international level

c. Publish primarily in English

d. Develop clear publication protocols

e. Create incentives to publish

f. Establish a minimal goal of publications for time unit

11. Produced knowledge should be applicable

Opportunities to research in our country are enormous. However, applied science is usually underestimated and therefore there is a loss of a lot of opportunities.

The future university should:

a. Develop research whose results can be used immediately

b. Consider the cost-benefits ratio

c. Get support from local, regional or international development agencies

12. Research should be guaranteed as an institutional responsibility

Honduran universities have limited budget which is primarily invested in the teaching dimension. However, universities should ensure an active and dynamic research mission.

To face the future universities should:

a. Propitiate national and international mobility of researchers.

b. Promote attractiveness and opportunities to explore the global dimension.

c. Potentiate basic research as well as the necessities of society and market as object of research.

d. Allow easy access to "Who is who" in knowledge production, knowledge use and exploitation.

13. Doctorate and Research Programs

Doctorate studies are knowledge factory worldwide. Universities without doctoral schools cannot be considered as future universities.

14. Collaborative inter-institutional relations (Networking necessary for all dimensions)

Strategic alliances are development tools. Honduran university should seek for collaborative inter-university programs in the national, regional and international level in order to be competitive in the

future. Relations with enterprises, government and research institutes are also relevant to improve the research dimension of higher education.

15. Extend the area of research to social, culture, society and values

The future university should be concerned more that in just traditional and pure science. Many problems of society could be solve through adequate research programs.

EXTENSION

16. Solid and long-term bilateral relation with communities

This social mission has been well developed in some careers; they should be a model for other careers. In the future university the sense to serve is not extension activities should be a responsibility of all careers. It should be of multidisciplinary nature, and should allow two way communication channel with communities. In this manner communities can suggest, propose or ask for some specific and necessary services or required knowledge transference.

17. Good practices exchange among institutions

A permanent platform to exchange good practices and learned lessons should be an important element of the future university. This will allow to improve and strengthen inter institutional relations.

18. Policies and initiatives related to national interests

A university with a vision of future should ensure an extension plan in concordance with the Vision of Country. This allows the activities of the university to impact the social-economic development of the country.

19. To develop a "sense of service" and equality as essential values

Even though some careers have done good contributions to society (medicine, nursery, law, among others), achievements are the result of a graduation requirement. An ideal university should strongly develop values related to serve and to reduce social inequity.

20. Inter and Intra-disciplinary projects

A good coordination among academic unities would allow to work some poles to be developed in an integral manner. With concrete policies, short and mi-term projects could be implemented with long-term impact.

21. Sensibility to identify needs

Extension done until today is mostly, remedial, assistive and reactive. However a university with vision of future should identify real necessities and anticipate them.

ADMINSITRATIVE MANAGEMENT

22. Change Management

The future university should be a dynamic institution, changing at pace of contexts' changes. It is a necessary element to promote permanent updating and innovation, to minimize change resistance, and to anticipate the future

23. Knowledge management as a tool for better performance of universities

Universities manage knowledge in an implicit way. However, KM should be a well-developed organizational tool for the whole dynamic of universities. Through this, systematization will be improved and a generation of takeover will be prepared. This tool will allow a systemic approach for administration and academy.

Regarding this, experts consider that in a university that manages knowledge:

a. Scientific knowledge is at the level of state of the art

b. It assures a context-dependent knowledge

c. Scientific information is completed with:

    a. Collectivity culture and team work

    b. Information society

    c. Change culture

24. Leadership skills for managers

University managers are academics. To strengthen leadership skills, with vision of future is a fundamental element for the development of any institution. This feature is in turn an enabler of change, and therefore of a better future university.

25. Academic autonomy with high level of quality

In the future higher education institutions should autonomous in many concerns, but mainly in their academic decisions. This is not intended to be confused with low quality programs; on the contrary, this should be complemented with criteria No.30.

26. Significant quote of self-sustainability

Since a critical factor for the development of university is the financial availability, universities, especially the public ones, should do strong efforts in self-sustainability. This can be achieved through the different university missions but also, and appropriate management tools. This includes looking for research grants, international cooperation and exchange, selling services, among others.

THE EXTERNAL DIMENSION

27. National policies with institutional flexibility

Higher education should have clear and concrete policies to orient each institution. This allows a frame to operate, and at the same time flexibility to institutional capabilities and objectives. Furthermore, this should include an educational model at the national level, with local vision but without losing sight of the international perspective.

28. Permanent dialogue spaces with other stakeholders

Universities should promote the creation of spaces to keep in touch with the government, civil society, NGOs, enterprises and other to constantly re-think their role and analyze their impact in social development.

29. Active involvement in solution of national problems

The university of the future is the one that is involved in the process of solving problems in society, researches their causes and proposes changes. On this basis they must generate useful information to decision makers.

30. Quality assurance

Self-assessment and external evaluations should be an ineludible commitment of the future university. Only in this way is possible to ensure quality, to be competitive in the regional and international level.

31. Prevalence of national over institutional interests

For the good future of higher education, to put aside institutional interests and to focus on Honduras development is a very important feature.

Chapter VIII – DISCUSSION

At the very beginning, this research was defined as generalist, systemic, and trans-disciplinary, qualities not usual of traditional paradigms of doctoral research. It is trans-disciplinary because it draws input from three different fields: first, higher education in Honduras, which is the scenario; second, biology of knowledge, with special focus on the contributions from neurobiology and autopoiesis; third, knowledge management as a tool to properly use the resource knowledge at universities. The common element to these three fields is knowledge, the informational and the cognitive approach.

Thus, the present study stems from the web of linkages between the need for change in higher education, the opportunities for new learning approaches from biology, and the insights provided by knowledge management. To do that, one of the aims of this study was to explore the future of higher education in Honduras through a Delphi consult. With this exploration, the expectation was to identify priorities for change and consensus for changes among a panel of experts. This in turn, would allow to select those elements where pertinent information from neurobiology and autopoiesis could be introduced.

The results described in the previous section show that experts were overwhelmingly conservative in their opinions. On the one hand, their answers did not propose an innovative ideal university. Their concerns are more related to fixing past and present problems, than anticipating the future. On the other hand, their suggestions were in many aspects in concordance with the international thinking about the future of higher education, as it is discussed below.

THE FUTURE OF HIGHER EDUCATION IN HONDURAS

It is recognized that deep changes are necessary in all domains of higher education institutions; the questions then become what changes to make, and where to make them. In order of priority, experts call for urgent changes in the teaching dimension, followed by changes in the administrative dimension. Some change is required in research and extension, but these aspects seem to be more specific and therefore easier to modify.

The literature shows that efforts at higher education reform have been made all around the world, including Latin America. However, they are frequently just minor modifications of past practices, and their relevance and impact is still disputable. No significant studies have been done that look at education reform in Honduras. Therefore, regional and international studies have been taken as references.

As a general observation, it is important to point out that even though learning strategies have changed in some institutions, changes in the classroom level are not evident yet. One can argue that as in many cases, top-down strategies has not been successful in pursuit of new forms of learning. Indeed, it causes confusion among those who should implement changes. This last was a remark form Honduran experts, while he was referring to a university that officially changes all its curricular offers to a competencies based approach. “Nobody knows what to do”, he stated, “in the classrooms they continue doing the same”.

Some individual initiatives have not been successful, neither, since permanent changes should take place in the institutional level.

As presented in Chapter II, many studies have been done in other countries to identify areas primed for higher education reform, but none in Honduras. This study presents the thinking of Honduran experts about the future of higher education for the first time; in this manner, information emerges about the necessities and opportunities for change in each of the classical tasks of Latin American universities: teaching, research, and extension. . In addition, changes in the administration and in better practices to improve relation with externalities are presented

The need for changes expressed by experts, with priority in the teaching-learning activities, is consistent with the literature. Thus, the situation was ripe to identify the spaces to introduce the contributions of biology of knowledge in the teaching-learning process. This is the last element to be discussed.

In the extension dimension…

From the four dimensions considered in this study, extension is the one that respondents commented on the least. On the one hand, experts agree that extension has

had enough attention from higher education institutions, and therefore there is a certain level of satisfaction in all stakeholders. On the other hand, there are still some efforts to be made to strive for an ideal university. As we can see in Table No. 10 and in Figure No. 46 ideal features for the extension dimension in the future are related to values and a better relationship with the communities outside the university, but a few are also intra-institutional.

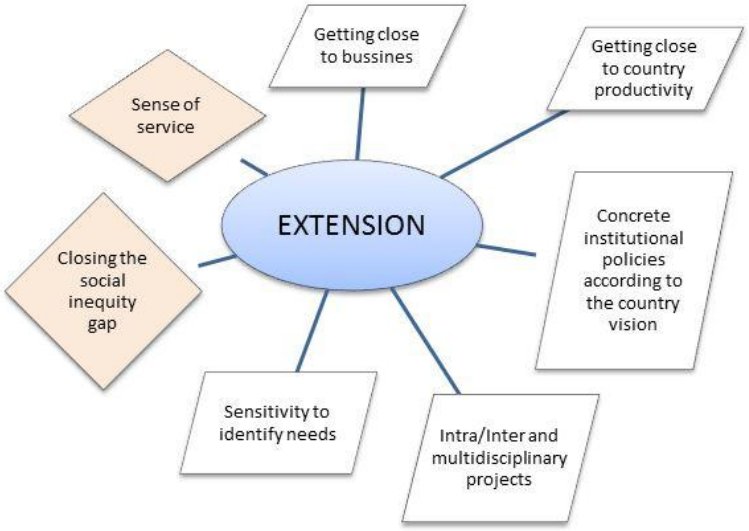


Figure No. 46 *Characterization of experts answers for the extension dimension (Source: self-developed)*

It is important to keep in mind that extension is a mission exclusively for Latin American universities, and it was conceived as an opportunity to return the privilege and the investment of governments to society. As such, the contribution of higher education institutions to the country's development through this mission has to be a very high level of priority.

In the research dimension …

One of the most important institutional commitments of the university is to create knowledge. Knowledge creation is done through research. Being radical it would be appropriate to say, that a higher education institution that produce not knowledge does not qualify to be called university, as some experts stated.

Honduran universities are very weak in their investigative capability. This is visible in the lack of researchers on staff, the lack of research skills in lecturers (and therefore in

students), and the lack of opportunities to get research training, among the others presented in Figure No. 47.

Although a lot has to be done to improve this dimension, expectations are poor because there is not financial support to continue improving research conditions. It would only be possible to have an ideal university in the future if this dimension is strengthened. Specific necessities have been shown in Table No. 10. Once again, potential improvement efforts can be grouped in terms of inter-relation with externalities (collaborative, contextualized); integral and multi-disciplinary approach (where values are again a focus of attention); development of research skills in all levels, and better institutional support.

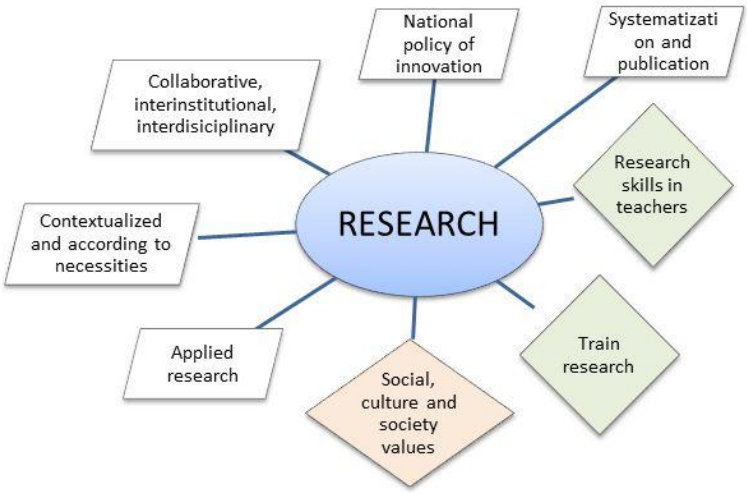


Figure No. 47 *Characterization of experts answers for the research dimension (Source: self-developed)*

About the administrative dimension …

The characteristics of the administrative dimension of an ideal future university can be clustered in five groups: change management, knowledge management, institutional policies, leadership, and networking, as shown in Figure No. 48 and Table No. 10.

Experts have stated that coming from centuries of certainties, modern society faces more uncertainties than ever. The idea of perennial knowledge, in teachers and students, should move to a transience approach. This is in concordance with the ideas that Morin (1999) prepared for the UNESCO in the document "Seven complex lessons in education for the future". Change management is a necessary element for promoting continuous updating and innovation, minimizing change resistance, and anticipating the future.

For knowledge management the overall opinion is vague, but experts agree that even though KM is not explicit in the institutional discourse, universities definitively manage knowledge. Without explicitly mentioning the knowledge process, experts suggest that university fails to create, acquire, communicate, and apply knowledge, both at the organizational level and at the individual level (see Section for KM below, for a deeper Discussion).

Figure No. 48 *Characterization of experts answers for the administrative dimension (Source: self-developed)*

Regarding institutional policies, the most relevant aspect was autonomy. Experts were influenced by recent social movements, asking for academic autonomy for every university. This is a very sensible point of discussion because the UNAH has, by law, total responsibility and control over the academic issues of all other universities. The UNAH decides what academic programs will a given university implement through its

Dirección de Educación Superior, which makes a choice based on university-specific indicators. Autonomy is not only an issue of preponderance in Honduras, but also in Germany where universities call for a higher level of autonomy (as presented in Chapter II). In addition, it was pointed out that institutions should improve their self-sustainability, as well as develop a vision of future and a systemic approach.

The necessity of leadership training is also an international concern. The lack of such training is a barrier of change, as the Delphi study "Trends 2020" states (OCU, 2010). The necessity for networking has been already discussed in other dimensions.

About the externalities …

The fact that experts recognized that the university and surrounding community are currently two environments working apart was one important result of the Delphi. Until now, higher education institutions in Honduras have nested themselves deep inside their own walls. The relation with the immediate environment is weak, and, therefore, the contribution of universities to the sustained social development of the country is minimal.

Although universities cannot do much to change externalities, experts' suggestions are on the internal side in order to improve the relationship with the external dimension.

As Honduras is a small and poor country, experts insist on joining efforts between universities and universities with other stakeholders (government, private enterprises, NGOs, etc.). A national policy that gives each university a harmonious orientation has been suggested as a necessary strategy. However, this policy should not be restrictive; on the contrary it should be flexible, and allow institutions to adopt and implement their own educational approach and strategy.

Definitively, universities should go beyond borders and improve their relations with all stakeholders in society; doing this is the only way to guarantee that the university provides pertinent and relevant contributions to social development. It is important for a national strategy to constantly review the role of higher education and change according to the environment. This includes attending to national necessities within a frame of permanent dialogue. As such, they should generate information that is useful to

decision makers, and propose solutions for national problems. This is especially important currently because, as presented before, the current social conditions are characterized by criminality, corruption, poverty, and unemployment.

Last but not least, the issue of quality assurance emerges in this point. According to the law of higher education in Honduras, this responsibility of quality assurance lies on the UNAH (see Chapter II). However, experts agree that there is a need for national accreditation agencies that are external to any institution, and with enough autonomy to ensure quality. Every accreditation agency would ideally have very qualified professionals, who can evaluate quality standards, but at the same time provide support and permanent assistance so that universities can improve their profile.

The future university should develop a collection of collaborative work with similar institutions, along with enterprises, government, and NGOs among others. To develop such work would require introduce deep changes regarding the traditional institutional schema that emphasizes competition over collaboration. Concerns in this dimension are focused on the necessary relation of universities with their environment.

DISCUSSING THE METHODOLOGY

The main advantage of using a Delphi Consult is that it permits the researcher to obtain an objective consensus of expert judgment on the subject under study. It also makes the rational underlying a specific estimate or prediction explicit for everyone (Strauss & Zeigler, 1975, p. 254). The main weakness of the Delphi Method is that a truly perspicacious expert's judgment might be lost when a consensus that actually represents a range of judgments is presented. Therefore, sometimes disagreement is more important to track than agreement. Additionally, it is clear that even proven experts are not always able to give an accurate prediction of the future events even in their special field. Delphi studies are validly criticized because they often being with varying ideas about the objectives, and, therefore, undifferentiated methodological standards.

As a methodology, Delphi has received both criticism and praise among the scientific community. However, the experience with this research shows the Delphi methodology to be a valorization process, which offers a great opportunity to get valuable information. It allows the expertise and wisdom of experts, which is usually underutilized or wasted, to be retrieved to a certain extent.

Since the Delphi intends to retrieve experience, the participants in this study are a representative group of experts, but they are only one out of many other possible perspectives regarding the future of higher education.

Nineteen experts were used for this research, with an overlap of four participants between the two rounds. The main risk of using different participants would be difficulty in achieving consensus. However that was not the case in this study; on the contrary, getting consensus in just the second round with different participants, and with an external (not national) point of view is an evidence for at least two things:

1. Problems and necessities of universities in Honduras are clear.

2. Experts' opinion is highly conservative, not proactive nor innovative.

Considering that during the second round experts were allowed the chance to add comments and new points of view, the minimal participant overlap during this research is not a weakness but a strength that contributes to the reliability of the data.

A possible way to refuse the weakness of Delphi surveys could be to determine as accurately as possible the potential and limitations of it. To use this Method, like any other instrument it will be useful to keep in mind the limitations. Moreover, a forecast is not a not a hard-bound inevitable. The resultant future can be modified following the well-known heuristic spiral rule.

With advantages or disadvantages, surrounded by myths or realities, allowing possibilities or restricted by some limitations, Delphi is one of the most controversial methods used to reach the opinion of stakeholders and decision makers with experience in some field.

Since experience is the sum of different precedents moments (view Concept of Knowledge in Chap. II Literature Review) and eventually it conduces to expertise and wisdom, it is convenient to rescue what experts have to say.

Despite all the controversial implications, Delphi has been used in this research upon the following considerations:

1. It is a predictive analysis method

This technique is just one of many (extrapolation, trend analysis, Bayesian analysis, etc.) that are useful in generating estimates or predictions. Also it is in line with the study purpose.

2. Experts have a well-based position

Every study has to take a sample, usually randomly. It is necessary to limit the characteristics of the sample members, like age, gender, or occupation. In this case, experience and expertise are the only criteria taken into account. Within these, however, the selection is random. Delphi is just a forum for experts' opinion that allows the focusing of different experts attention on the same situation.

3. Thinking about the future is absolutely valid but not contundent

With only a few exceptions, human society focuses its actions and energy on solving past and present problems, and expends little on preventing future problems. This research is not an exercise in predicting the future, but in creating dream about the future and generating new debate and research. If ones accept that "… the Delphi technique is of value not in the search for public knowledge, but in the search for public wisdom; not in the search for individual data but in the search of deliberative judgment …" (Coates, 1975; extract by Linstone, 2002, p. 559 - 560) there should be no objections about the use of this technique.

WHAT ABOUT KNOWLEDGE MANAGEMENT IN HONDURAN HIGHER EDUCATION INSTITUTIONS?

A remaining question is if knowledge in higher education institutions is "manageable". Until certain extent, it is possible to use same tools as in any other organization, but universities pose specific requirements that cannot be met through the use of the traditional models of KM. As Erne (2001, pp. 169 - 171) mentions, universities face specific conditions that complicate management activities e.g. academic freedom, the relevance of the scientific community over the administration, and the unity of teaching and researching.

Knowledge is the most important resource at the university. The ability to adapt the diverse use of knowledge in a coherent and structured strategy will lead to an effective and useful knowledge management. In the case of higher education, it will be concerned

with a wide range of practices related to produce, transfer and apply knowledge in the organizational as well as in the individual level.

At the present time, the application of KM to higher education institutions is still not clearly and adequately addressed. According to the results of this study, interviews show that the KM process at universities is not operationalized in practice. Experts say that even when universities manage knowledge in an implicit manner, KM as a tool is not a practice.

While the use of KM in organizational context has been wide discussed, this study demonstrates the relevance of KM in an institution that moves around knowledge. The difference in comparison with previous studies lies in the fact that enterprises where KM was developed and applied do not work with people and their knowledge as "products". The human variable at the university runs in all directions. Human action is not restricted to employees and employers; it involves also the "products" in this enterprise, the students.

The lack of KM is not restricted to Honduran universities. Johnson (2001, p. 143) says the overlapping functions and structures that deal with human beings and the "vital" work with these human beings in universities is far from being an active and integrated part of a comprehensive management process – if one can even speak of such a thing at universities. Now as ever-restrictive structures, traditional attitudes and reactive administrative activities dominate creative and proactive crucial functions. This is made even more regrettable by the fact that the success of universities is especially dependent on the performance that human beings bring to their work.

Moreover, human beings are not only workers, but also "work material". This makes the issue of KM complex, and therefore makes it absolutely necessary to develop an integrative point of view in the sense of a systemic approach for the management of knowledge at higher education institutions.

Since KM is not a widespread practice in universities, there is no assurance that managers are familiar enough with this concept to act as knowledgeable key informants. Yet, their responses form an important indicator of the purpose of knowledge management practices in the eyes of individuals who ultimately are responsible for directing and supporting such practices. A study of lecturers and researchers who have

participated in these activities might confirm or disconfirm these findings; in the latter case, the specific ways in which employees' experiences differ from managerial perceptions might be a very useful diagnostic for assessing the relationship between a practice's intended and actual effects.

Because of that, KM at the university requires every academic to practice appropriate management of knowledge in his or her teaching and learning activities, which includes the whole process of knowledge: generating, acquiring, storing and disseminating it effectively to users, especially students. In contrast with other kind of organizations, KM in higher education institutions begins, and is related mainly to the individual level, with focus on the student. Each person should be able to develop the knowledge process according to her/his own necessities, wishes, and capabilities. This leads to the implementation of learning theories that (Probst & Rohmhardt, 1997) highlight- the learning process as an individual experience (see Figure No. 46).

Individual Knowledge Management

Traditionally KM has been an organizational tool, however as such it has had small impact in higher education institutions. The suggestion in this thesis is that as a tool, it should not be restricted to the already well-known organizational strategy. On the contrary, the transfer of the KM organizational tool has an important potential in the individual level. KM would then mean: *the improvement of individual capabilities and skills through a better understanding of the knowledge process.* Teaching-learning processes have been centered in Knowledge organization, using the declarative memory as indicator of successful.

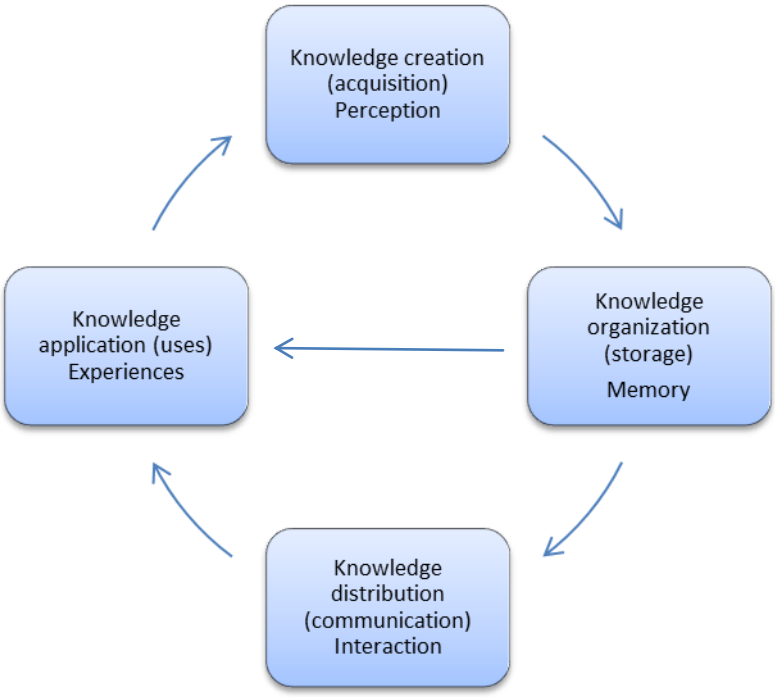


Figure No. 49 *The knowledge process in the individual level*
(Adapted from Alavi & Leidner, 1999)

However, the individual level could result more productive and interesting in the field of higher education if they are understood as centers to develop competencies and learning abilities of individuals. In this sense, KM is not only important for professors, it is also important (and maybe even more) for students. If they are informed and introduced in the dynamic process of KM they will develop an important tool for lifelong learning. To this, the most recent results of brain research and the pedagogical psychological approach should be fed into a KM strategy to moves closer to a bio-psycho-sociological approach to learning process. Such a strategy seems to be a crucial factor for changing the learning-teaching culture from a teacher-centered methodology to a learner-centered one.

Some benefits in the individual level have been already addressed by Anand (2011) who points that it helps to:

- … identify, capture, acquire and embody knowledge …
- … assure that learning is meaningful (for personal or organizational purposes) …
- … identify the best way to learn …
- … bring tacit knowledge to the surface …
- … capture expertise and knowledge created by knowledge workers …

- … share experiences and expertise …
- … increase the knowledge acquisition capability …

To face the actual situation of higher education with a vision of future means to deal with a high complex system where a systemic approach in the organizational dimension seems to be a necessity. Other non-educational institutions have found a very powerful tool in knowledge management, however this tool has not been explored enough in its uses in higher education institutions. Moreover, since universities works with "knowledge" as main resource, KM in higher education institutions is more complex, and needs a different approach than in other organizations.

A FURTHER RESULT: THE NEW LEARNING CONCEPT

Learning, in the sense of the process of storing information about the environment, is a very primitive biological trait. It is the continuous process of adaptation to a changing environment. Translating this idea to learning scenarios, how can we expect that teaching and learning strategies in the present time would be successful? Compared with past practices higher education is only slightly different.

Even though experts are aware of the necessity for change, changes are not palpable despite a variety of efforts that have been put forth. Experts' suggestions for the future of higher education institutions are presented in Table No. 10. These attributes of an ideal university were re-organized into the BRAIN Model.

The BRAIN Model encompasses five categories, which are the elements that should be taken into account to adapt the university in concordance with necessities and demands of a global society.

More than a new learning model, it intends to provide a frame that every single learning theory should consider in order to educate people for the future.

Through this model, we return back to the axes of this study. The model introduces the biological features related to autopoiesis and neurobiology, because they are relevant to the learning process and they complete the ancient learning-teaching strategies. However, neuroscience is on the brink of developing new methods for recording neural activity during the learning process. Neuroscientists do not fully understand how the brain manages to extract meaningful information from all the signaling that goes on within it (Sejnowski & Dellbruck, 2012, p. 56).

The contributions of neurobiology are therefore not ready to be applied in the educational field, but instead waiting for these results, classrooms should become active labs for neuroscientists. The fields have been working apart, underestimating the potential of a close collaboration. In that sense, it is time for biology to re-define its field of action and to develop the new *life sciences*.

The BRAIN Model - TOWARDS A BIO-PSYCHOSOCIAL LEARNING CONCEPT

The better use of the knowledge resource at university demands a trans-disciplinary holistic approach, accepting that neither biology, nor psychology, nor sociology can improve the performance of the teaching-learning process by itself. Instead, they need to work together and support each other with new discoveries and new interpretations. The combination makes it possible to suggest a bio-psychosocial, or a BRAIN model for a learning theory.

This model intends to be a guide for any learning approach that is intended to be introduced in higher education institutions. It encompasses the different elements that must be considered to get better performance from learners. This model has been developed on the basis of an ideal higher education according to Honduran experts, which is not quite different from the ideal of the international community.

Biography, as the sum of experiences and its role in learning processes has been widely discussed in education. Concepts such as learning (either biographical learning or narrative learning) refer to this aspect, arguing that learning is greatly influenced by the previous experiences of learners. According to Maturana & Varela's theory of cognition, learning takes place through experience. Experience in turn, modifies our perception of the surrounding world, and our attitude toward new experiences. This means that learning experiences are developed on the basis of previous experiences, and any new experience will be a new basis for future experiences.

Relations, learning is all about connections, and through our connections with unique people (and unique experiences) we are able to gain a true understanding of the world around us (Senge). Learning does not take place in isolated passive contexts. It requires action and interaction with the surrounding environment. By this, learners take in information about the elements of their surrounding context; they are modified through these relations, and they simultaneously modify others in a systemic dynamic. This reinforces the idea that learning is socially determined. It promotes social, collaborative, and responsible learning. The natural networking life strategy (systemic) is included with this element, which allows context specific learning at the same time.

Autopoiesis as the characteristic of self-production in living beings plays a major role in learning. Even though previous experiences and relations with the environment influence the individual, how he or she reacts to them is internally determined. Externalities can disturb the self and modify it, but at the end the individual needs to keep its internal organization. Following this idea, the learning process is an autopoietic one, but teaching instead is interference. This interference should be designed to fit the needs of the individual. Autopoiesis means implicitly autonomy, individuality and systemic.

Integrity refers to values and principles that should be considered in every teaching-learning experience. Society complains about a new generation lacking values. For Honduran experts, this is one of the most regrettable gaps in learners, and is also a concern for the international community. Ethics, responsibility, respect, honesty, and tolerance were mentioned over and over again by experts. Real learning gets to the heart of what it means to be human. Through learning we re-create ourselves. Through learning we become able to do something we never were able to do. Through learning we reperceive the world and our relationship to it. Through learning we extend our capacity to create, to be part of the generative process of life. There is within each of us a deep hunger for this type of learning. (Senge- fifth discipline)

Neuroscience comprises the contribution from psychology and neurobiology. Psychology has been a strong basis for the learning approaches in use, however results from neurobiology are not clear enough to be applied on the educational field. Since this century is designed to be the century of neurobiology, a rapprochement between this and educational science is necessary. Knowing the know and the underlying biological

phenomena of knowledge will doubtlessly contribute to improve the teaching-learning process.

This model is characterized by:

1. **Being learner centered:** more than ever this model promotes a learner-centered strategy.
2. **Recognizing knowledge as a human condition:** it is developed and achieved through experience.
3. **Focusing on individual learning:** using self-determination towards necessities and aspirations.
4. **Incorporating flexibility:** because needs of every individual differ from one to another.
5. **Making use of relevance**: personal development over content development

A BRAIN Model is the simplest model for a comprehensive individual knowledge construction. It guides teaching-learning approaches towards facilitating the learning process, which, in turn, develops skills, competencies, abilities, and attitudes that contribute to a lifelong learning culture.

This model imbues the learning process with the following attributes:

1. **Significance:** every learning activity based on biography is significant.
2. **Pertinence:** because learning in context through interaction with others and with the surrounding environment.
3. **Facility:**
4. **Human sense**
5. **Relevance:** through memory and skills development

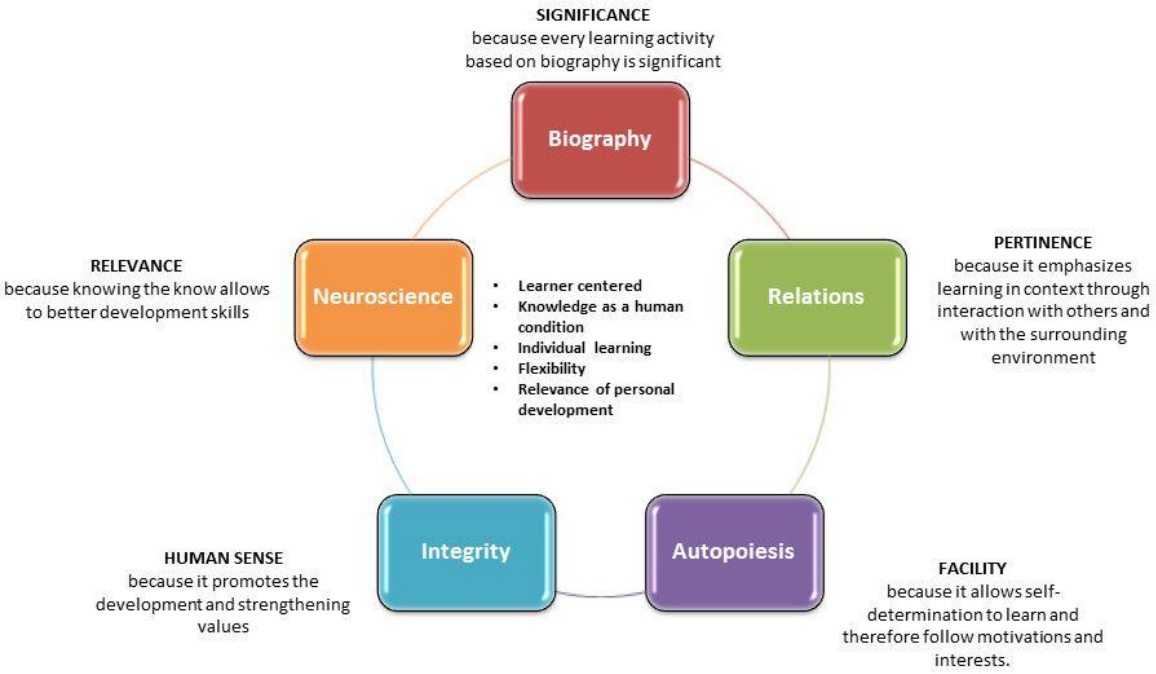


Figure No. 47 *The BRAIN Model in short*

LIMITATIONS

While results described in this thesis are consistent with previous research and with theories used to frame the study, they should be treated with caution for several reasons. First, because of the selected methodology, they are based on a small sample. Second, other important stakeholders should have the opportunity to express their opinion; the experience-based view of experts is undoubtedly valuable, but teachers and students could contribute to the development of an integral model for learning and teaching in higher education.

In addition, the study was conducted in Honduras and the national conditions at the moment played a major role in experts' opinion. A limitation to generalize because of geographical, social, and sample reasons is therefore clear.

The current state of neurobiological findings is not clear enough, to be applied in the learning process as it was desired at the beginning of this study.

CONTRIBUTIONS TO THE FIELD

The main contribution of this study is to make explicit, the expertise, know-how, concerns, and ideas of a conglomerate of experts. This is especially relevant to the current cultural context for different reasons. First, it propitiates the generational communication and favors the preparation of a takeover generation. Second, the contribution of a list of criteria to improve higher education and a new learning concept, seem to be a good answer to the call for a better Honduran society. Third, it opens the door to a new trans-disciplinary experience, promoting collaboration over competition among fields of discipline previously working apart. Fourth, since research is not favored in Honduras, any solidly based research experience represents a huge contribution to the country's development.

Specific contributions are:

1. **A list of criteria to be considered for the future of higher education in Honduras**

   This is the first well-documented contribution regarding the future of higher education in Honduras. This list is a guide that summarizes the opinion of experts in the field of higher education in Honduras. As such, it provides a significant input to orient different stakeholders towards a university with the level of the twenty-first century. All university missions are included in this list of criteria. It is a valuable tool considering that the source of the information includes a thorough literature review regarding the future of higher education in the international dimension.

2. **A conceptual model as a transition towards a new learning approach**

   The data collected was deeply analyzed and re-organized. This process allowed the development of the BRAIN Model, a concept to frame any learning approach. This model is innovative because it propitiates eclectic approaches. Experts agree that flexibility and academic freedom are necessary conditions for an ideal university. Thus, this model is intended to orient any learning approach towards these goals, regardless of mediation, contents, or methodologies. It does not seek to put forth a new learning approach entirely, but to reframe the existent ones. This means that the learning approach that is eventually implemented could be different, but they should also consider elements of the BRAIN model.

3. **An individual approach to knowledge management**

   Even though this approach is not new, its application to learning processes is. It should be further developed and experienced in classrooms to better understand its utility.

4. **A deep reflection about the present and anticipating the future of higher education**

DESIDERATA

The explorative character of this study opens a lot of new avenues for additional research in different fields. Further studies should be done with other stakeholders to give a more representative view. Also, new applications to learning concepts and approaches should be explored by interviewing the main actors, lecturers, and students. The communication bridge between biology and pedagogy should be strengthened. Pedagogy should allow classrooms to become living labs for multidisciplinary research.

CONCLUSION

Institutions of higher education are aware that they need to change. They cannot continue in the same way they have for hundreds of years because the opportunities and necessities of the current climate, differ greatly from antiquity. Wherever there is an interaction all participants in this interaction will change to keep everyone in its internal equilibrium from an autopoietic point of view,.

While the results reported in the previous chapter are from a small-scale exploratory study, they appear to be significant at least in the following respects:

1. Honduran higher education seeks to move to a learner-centered education paradigm, which is in concordance with global trends.
2. A new education based on strong moral values is a high priority to recover social peace and welfare.
3. There is a need for a more context-oriented education.

There are two major drivers behind the push towards the future: the critical current socio-economic situation, where the high level of criminality plays a major role, and the trends in the international dimension, which pull small countries to move on this direction.

Findings in the current study are aligned with those of a number of recent studies on higher education in the international dimension, with some specific remarks related to the context as it is discussed in section below.

One could expect that there are different necessities between well and less developed countries. However, the results described in the previous section are consistent with previous studies that have explored the future of higher education in well-developed countries. Questions about training teachers, encouraging interdisciplinary cooperation, bettering accessibility, networking, dealing with context-dependent knowledge, developing skills and competencies, furthering leadership skills for managers, encouraging self-learning, learner-centered paradigms, flexibility, values, and so on … were frequently mentioned by Honduran experts in the open-ended questions of first round, and consensus about them was clear during the second round.

But no matter how well crystalized or articulated the necessities are, the reforms currently being enacted are not reforms in the way of thinking or general conceptualization, and therefore they only serve as a temporary salve, following the results of a UNESCO study (Lanz, Fergusson, & Marcuzzi, 2006, p. 110). Efforts to advance to a concept-integrated education should remind us that reanalyzing how the teaching-learning process is organized has the potential to profoundly affect learning outcomes.

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STATEMENT OF DECLARATION

I hereby declare,

- That I have made the work presented myself and acknowledged all aid in the work,
- That I do not have submitted this dissertation as an examination paper for any scientific testing, and
- That neither the same nor another treatise of the thesis at another university or another department of the University of Kaiserslautern has been published.

Virna Julisa López

Kaiserslautern, 31.01.2013

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Hiermit versichere ich,

- dass ich die vorgelegte Arbeit selbst angefertigt und alle benutzten Hilfsmittel in der Arbeit angegeben habe,
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